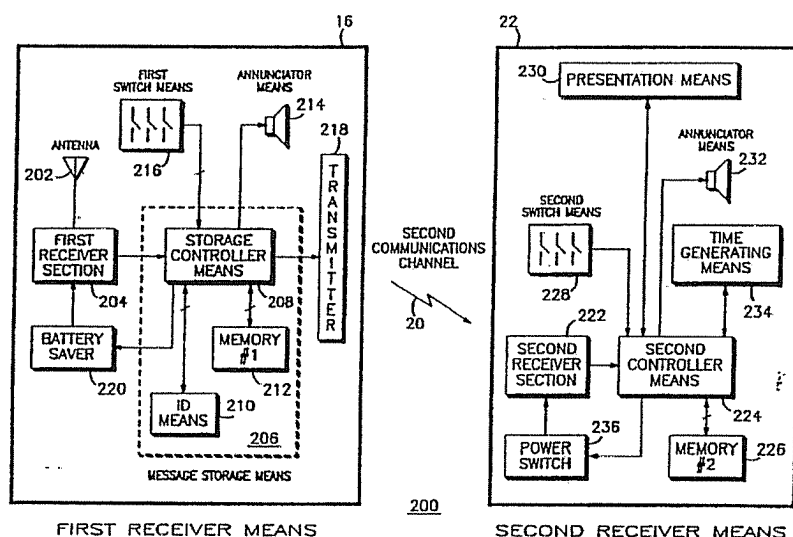




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(54) Title: PORTABLE COMMUNICATIONS RECEIVER WITH SEPARATE INFORMATION PRESENTATION MEANS AND IMPROVED BATTERY SAVING FUNCTION



## (57) Abstract

A personal communications device is described including a receiver (16), intended to be worn on the body, which receives, detects and stores messages transmitted on a first communication channel (14). The stored message is then transmitted over a second communications channel (20) to a second receiver (22) which is intended to be worn on the wrist. The second receiver (22) receives, detects and stores the message, and presents the message to the user in the form of a visual display. A system transmitting synchronization signals and coded message signals is also described. In particular, coded synchronization signals are used to indicate the transmission of coded message signals or the absence of transmission of coded message signals following the transmission of the coded synchronization signal, thereby providing a battery saving function for a personal communications receiver.

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PORTABLE COMMUNICATIONS RECEIVER WITH SEPARATE  
INFORMATION PRESENTATION MEANS  
AND IMPROVED BATTERY SAVING FUNCTION

FIELD OF THE INVENTION

This invention relates to radio communications receivers in general, and more particularly to portable radio communications receivers having means separated from the receiver for the presentation of the received information and having an improved battery saving function.

BACKGROUND OF THE INVENTION

Numerous portable radio communications receivers are currently available which include means for the presentation of information, such as voice messages, phone numbers or other information. One such portable radio communications receiver having either a display for the presentation of information received over a radio communications channel, or audio circuits for the presentation of received voice messages, is the radio paging receiver. Radio paging receivers, or pagers as they are often called, utilize selective call signalling to direct messages to both individual pagers and groups of pagers. This is accomplished by transmitting uniquely coded tone or digital signals, called addresses, which are used to identify each individual pager, followed by the transmission of the message, either a voice message or encoded data message.

In the case of a pager receiving data messages, the pager to which the message is directed generally

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stores the message and responds with an audible alert indicating a message has been received. A display, which may be located on the top, the front, or the side of the pager, is used to present the message. Switches or pushbuttons are provided for controlling the operation of the pager by the user, as for example to reset the audible alert or to recall a stored message for review. Depending on the design of the pager and the display location, a pager is generally more suited to be worn on the belt or carried in the shirt pocket. Some pagers may be worn comfortably in either position, although access to the pager controls and viewing of the display will be compromised. Even when the pager is worn in the intended position, the display is often difficult to view without removing the pager and repositioning it to view the display.

Various proposals have been made to overcome the difficulties of viewing the display. One such proposal is that of the "pager-watch", wherein the receiver and display electronics are included in a compact wrist worn configuration. However, this approach, while it may solve the problem of viewing the display, creates several new problems. Foremost among these are problems relating to battery life and receiver sensitivity.

Portable communications receivers, and more particularly paging receivers require a substantial battery to power the receiver and decoder electronics in order to provide acceptable battery life. Battery saving circuits are generally employed to reduce the overall power drain of the receiver electronics. Newer technologies, such as microprocessors are being used to integrate a variety of functions, such as those associated with

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decoding and message presentation to further minimize power consumption. Improvements are still needed to increase battery life, even with the use of new technologies noted above. One such area  
5 relates to improvements in battery saving performance which is achievable by modifying system operation based on loading.

Current battery saving methods do not provide for changes of loading on a system. This is  
10 especially true in the evening and night hours when the loading on a system is substantially less than the daytime hours. Most battery saving methods provide only predetermined operational characteristics which are constant throughout the  
15 day. Adjusting the battery saver operation in lightly loaded periods can greatly increase battery life.

Current battery saving methods are also only effective in conventional paging systems where all  
20 receivers are either synchronized to a common transmission or which require long preambles, as in the case of non-synchronous systems. These methods have limited application beyond their originally designed operation. There is a need for a battery  
25 saving method which not only improves the performance on a conventional paging system, but which may also be applied to a secondary channel where information received on the primary channel is retransmitted to a second receiver on a secondary  
30 channel. Since the transmissions to the primary receiver are completely random, any retransmission of information occurring on the secondary channel would be expected to be completely non-correlated with those of the primary channel. It is  
35 contemplated that many retransmissions of

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information from many different transmitters operating on a common frequency would occur on the secondary channel. In this case, a method of not only providing a battery saving function based on system loading is required, but also one which provides security in the transmission is required to prevent receivers, other than to which the transmission is intended, from receiving the transmitted information.

#### SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a portable communications receiver which provides convenient presentation of messages.

It is a further object of the present invention to provide a portable communications receiver which utilizes a separate presentation unit for the display of received data messages.

It is therefore an object of the present invention to provide a portable communications receiver with an improved battery saving function.

It is a further object of the present invention to provide a portable communications receiver with an improved battery saving function that can adjust for loading on the system.

It is a further object of the present invention to provide a portable communications receiver with an improved battery saving function that also can provide security in the transmission of information.

A system for transmitting synchronization signals and coded message signals is described which uses coded synchronization signals. The coded synchronization signals indicate the transmission of coded message signals and the absence of

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transmission of coded message signals following the transmission of the coded synchronization signal, thereby providing an improved battery saving function. Two coded synchronization signals are provided which are coded binary words. The coded synchronization signals are complements of each other.

These and other objects and advantages of the present invention will become apparent to those skilled in the art upon consideration of the following description and accompanying drawings of the present invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention itself, together with its further objects and advantages thereof, may be best understood by reference to the following description when taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify identical elements, in which and wherein:

FIG. 1 is diagram showing an application of the preferred embodiment of the present invention.

FIG. 2 is a functional block diagram of the apparatus of the present invention.

FIGS. 3A-C are diagrams of the synchronous signalling format utilized in the preferred embodiment of the present invention.

FIG. 4 is a diagram of the first receiver means implemented using a microprocessor for the preferred embodiment of the present invention.

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FIG. 5 is a diagram of the second receiver means implemented using a microprocessor for the preferred embodiment of the present invention.

5 FIG. 6 is a pictorial view of the wrist worn presentation unit in the preferred embodiment of the present invention.

FIG. 7 is a table describing the annunciator functions of the wrist worn presentation unit in the preferred embodiment of the present invention.

10 FIG. 8 is a flow chart describing the switch functions of the wrist worn presentation unit.

FIG. 9 is a flow chart describing the channel acquisition mode used in the preferred embodiment of the present invention.

15 FIGS. 10A-D are diagrams describing the Golay Sequential Code signalling format.

FIGS. 11A-C are diagrams describing the interleaving of multiple transmissions on a single channel in the preferred embodiment of the present invention.

20 FIG. 12 is a diagram of the secure synchronous signalling format utilized in the preferred embodiment of the present invention.

FIGS. 13A-C are diagrams describing the POCSAG signalling format.

25 FIG. 14 is a flow chart describing the modified channel acquisition mode used in the preferred embodiment of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

30 Reference is now directed to the drawings, and more particularly to FIG. 1, which shows a typical diagram of a communications system 10 incorporating the preferred embodiment of the present invention. As shown in FIG. 1, a communications transmitter 12



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transmits coded message signals in the form of selective call messages, or pages, on a first communications channel 14 to a portable radio communications receiver, or pager 16. It will be appreciated that communications system 10 need not be limited to a single transmitter as shown, but may include communications systems with multiple transmitters as well.

The transmitted selective call messages include addresses identifying the pager to which the messages are directed. The addresses are generally followed by voice or data messages. One or more of these transmitted selective call messages may be directed to pager 16 as shown in FIG. 1. Pager 16, in this case, is carried on the belt of user 18. It will be appreciated that pager 16 may be carried in other locations equally as well, such as in a shirt or pants pocket, or in a purse. The transmitted selective call messages are received and detected by pager 16. The addresses are decoded in a manner well known to those skilled in the art, and those addresses directed to pager 16 result in data messages being stored and a sensible alert, which may be audible or tactile, being generated. When voice messages are transmitted, which follow the address, the sensible alert is first generated followed immediately by the voice message.

The voice or stored data message is then transmitted using a low power transmitter located in pager 16 on a second communications channel 20 to a separate wrist worn message presentation unit 22. Second communications channel 20 in the preferred embodiment is a low power FM signal, although other forms of non-wire communications, such as ultrasonic

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and infrared signals, or other radio frequency signals as low power AM, could be used equally as well.

The messages transmitted on second  
5 communications channel 20 are received and detected  
by presentation unit 22. The messages received are  
then presented to user 18 as a visual display for  
data messages or audibly for voice messages. By  
locating presentation unit 22 on the wrist, user 18  
10 can readily respond to the received message by  
moving presentation unit 22 to a position which  
allows convenient viewing or listening of the  
received messages. It will also be appreciated that  
presentation unit 22 may take other forms as well,  
15 such as bracelets, pendants, necklaces or the like,  
which can perform the same function of allowing  
convenient viewing or listening of the received  
messages.

Reference is now directed to FIG. 2 which shows  
20 a functional block diagram of the apparatus 200  
comprising the preferred embodiment of the present  
invention. Pager 16 of FIG. 1 corresponds to first  
receiver means 16 which consists of a first receiver  
section 204 and antenna 202, capable of  
25 receiving the selective call messages transmitted on  
first communications channel 14. The output of  
first receiver section 204 is a demodulated signal  
which includes the selective call addresses and  
associated voice or data messages. The output of  
30 first receiver section 204 couples to message  
storage means 206 which provides selective call  
decoding functions, and controls message storage and  
retransmission of stored messages on the second  
communications channel 20 to second receiver means

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22, which corresponds to presentation unit 22 of FIG. 1.

Message storage means 206 consists of storage controller means 208, identification (ID) means 210  
5 and memory #1 or first memory means 212. Identification means 210, consists of a read-only memory, such as an EEPROM (electrically erasable programmable read only memory), which stores one or more predetermined addresses identifying those  
10 messages to which first receiver means 16 will respond. Storage controller means 208 provides the decoding function, in a manner well known to those skilled in the art, by comparing the received addresses with the stored predetermined addresses.  
15 When any of the received addresses match those stored in identification means 210, storage controller means 208 stores the subsequently received data message in first memory means 212. A sensible, audible or tactile, alert is then  
20 delivered by annunciator means 214 indicating a message has been received. In the preferred embodiment of the present invention, first memory means 212 is a random access memory capable of storing multiple messages. Storage controller means  
25 208 also formats the stored messages in a serial fashion for transmission by transmitter 218 to second receiver means 22.

First receiver means 16 also includes switch means 216, consisting of manually actuatable,  
30 switches, for controlling first receiver means 16 functions, such as ON/OFF, RESET and TRANSMIT. The ON/OFF function turns first receiver means 16 power on and off. The RESET function allows manual reset of the sensible alert prior to an automatic time out  
35 period, such as eight seconds. The TRANSMIT button

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allows a data message which has been stored in first receiver means 16 to be retransmitted. Multiple actuations of the TRANSMIT button allows transmitting the current message, as well as previously received messages to second receiver means 22 where they may be readily viewed.

As previously stated, the secondary communications channel 20 is a low power FM signal in the preferred embodiment, linking transmitter 218 located in first receiver means 16, and second receiver section 222 located in second receiver means 22. The serial data message from I/O Port 442 couples to modulator 444, the output of which couples to transmitter 446. FSK modulation is used in the preferred embodiment, although other modulation methods can be used as well. The low power FM transmitter can be designed to operate on any of the unlicensed frequencies authorized by the FCC, Part 15, Section 15.101, eliminating the need to separately license the wrist worn presentation unit.

The output of second receiver section 222 is a serial stream of information corresponding to the serially transmitted data messages, or an analog signal corresponding to the voice messages. The output of second receiver section 222 couples to second controller means 224, which controls the storage of the received data messages in memory #2, or second memory means 226. Second memory means 226 is preferably a random access memory providing storage for at least one data message. Second controller means 224 also controls the delivery of the received voice and data messages by presentation means 230 or annunciator means 232.

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Time generating means 234 couples to second controller means 224 and provides watch functions, such as time, and day and date which are displayed on presentation means 230 when data messages are not being presented. Annunciator means 232 couples to second controller means 224 and provides a sensible alert, either audible or tactile, for indicating a message has been received and stored. Audible alarm functions for time keeping means 234 are also provided by annunciator means 232.

Second switch means 228, consisting of manually actuatable switches, couples to second controller means 224 and provides control of time generating means 234, such as setting the time or alarm. Second switch means 228, also provides control of message presentation, such as recall of the data message stored in second memory means 226, and reset means for resetting the audible alerts provided by annunciator means 232.

In order to conserve battery drain, first receiver means 16 also can include a battery saver circuit 220. The operation of battery saver circuit 220 as used in a conventional paging receiver is well known to those skilled in the art.

It will be appreciated by those skilled in the art that from the description of the preferred embodiment of the present invention already provided, first receiver means 16 may be constructed in a manner somewhat similar to a conventional paging receiver. Consequently, excellent receiver sensitivity, immunity to falsing, and reliable voice and data message reception are obtainable as in a conventional paging receiver. The battery used to power first receiver means 16 may also be selected to provide battery life at least as good as

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conventional paging receivers, given the high current requirements of a quality communications receiver. By storing all received data messages in first memory means 212, the user is insured all messages directed to him/her are available for review. Even when the transmission to second receiver means 22 is corrupted, such as by blocking either transmitter 218 transmission or separate wrist worn receiver 22 reception, data messages are recoverable by simply recalling the last message received as previously described. An indication is provided by the separate wrist worn receiver when loss of message occurs which will be described in detail shortly.

It should also be noted, that a certain amount of redundancy is built into the preferred embodiment of the present invention. This is particularly true with respect to first annunciator means 214 and second annunciator means 232. By means of first switch means 216 and second switch means 228, the user can select the alert to be delivered from only one annunciator or both. Since the volume producible by first annunciator means 214 is greater than that deliverable by second annunciator means 232, first annunciator means 214 may be selected when ambient noise levels are high, and second annunciator means 232 may be selected when ambient noise levels are low, as an example.

In the preferred embodiment, second receiver means 22 is constructed to minimize current drain requirements. This is accomplished through the use of low current drain components for the circuit elements, as will be explained in detail later in the specification. Current drain is further minimized by using a synchronous data message

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transmission on the second communications channel  
20. Reference is now directed to FIGS. 3A-3C which  
shows a diagram of the synchronous signalling format  
300 employed in the present invention. The  
5 signalling format shown is an adaptation of the  
Golay Sequential Code format widely used by the  
assignee of the present invention for non-  
synchronous data transmission, which has been  
adapted for use in a synchronous system. It will be  
10 appreciated, other selective call signalling  
formats, such as the POCSAG signalling format which  
is a synchronous signalling format, could also be  
adapted without departing from the scope or spirit  
of the present invention.

15 As shown in FIG. 3A, synchronization signal 302  
is transmitted at least once during a periodically  
generated time interval 304, which in the preferred  
embodiment of the present invention is sixty  
seconds. It will be appreciated by one skilled in  
20 the art that this time interval can be longer or  
shorter without departing from the scope or spirit  
of the present invention.

Data messages are transmitted on first  
communications channel 14 using conventional  
25 synchronous or asynchronous signalling formats which  
are well known to one skilled in the art. It will  
be appreciated that data messages can be received  
during time interval 304 when second receiver means  
22 is not responsive to receiving the data messages.  
30 So as to avoid confusion, the alerting signal  
normally generated by first receiver means 16 upon  
receipt of the data message over first  
communications channel 14 is delayed until after the  
data message has been transmitted to second receiver  
35 means 22. Time interval 304 is selected to maximize

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battery life while maintaining an acceptable time delay from receipt of a data message by first receiver means 16 to presentation of the data message by second receiver means 22. At sixty  
5 seconds for time interval 304, the average delay from receipt of a data message to presentation of the data message is thirty seconds. The data messages are transmitted following synchronization signal 302, and one or more data blocks 310 may be  
10 transmitted, as shown in FIG. 3A. When multiple data blocks are transmitted, a synchronization signal precedes the transmission of each data block, as shown. Data messages are also transmitted after actuation of the TRANSMIT switch by the user,  
15 retransmitting the previously stored message. Since data message transmission occurs only a relatively small number of times each day, most transmissions include only the synchronization signal. As in conventional synchronous transmission systems,  
20 second receiver section 222 is powered for a time long enough to receive both the synchronization signal and at least the first data block. When the synchronization signal is transmitted without a data message, inverted (i.e. complemented)  
25 synchronization signal 326 is transmitted in place of synchronization signal 302. When inverted synchronization signal 326 is detected, power to second receiver section 222 is suspended immediately after the synchronization signal, increasing the  
30 battery saver performance.

As shown in FIG. 3C, synchronization signal 302 consists of nine bits of comma 306 and a twenty-three bit synchronization word 308, which is common to all second receiver means 22. The transmission  
35 rate for synchronization word 308 and data block 310



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is 600 bits per second, although other data rates could be used equally as well. When the synchronization signal is inverted, as previously described, this is accomplished by inverting the  
5 synchronization word. Comma 306 is an alternating one-zero pattern transmitted at twice the bit rate of synchronization word 308 for a time period equivalent to nine data bits. Synchronization word 308 is a single 23,12 Golay coded word. The last  
10 bit 324 of comma 306 is always of opposite phase to the first bit 312 of synchronization word 308, as shown in FIG. 3C.

Comma 306 is generated before synchronization word 308 for two purposes. Comma 306 insures that  
15 when second receiver means 22 begins receiving the synchronization signal, uncorrelated data is initially received, thereby insuring proper decoding of synchronization word 308. In the preferred embodiment of the present invention the decoding of  
20 synchronization word 308 is accomplished using a "block" decoder. Such a decoder is described in U.S. Patent Number 3,801,9228 to Braun et al, entitled "Digital Sequence Detector Using Multiple Samples During Each Digit Time Period" which is  
25 assigned to the assignee of the present invention and which is incorporated for reference herein. The "block" decoder provides synchronization of second receiver means 22 with first receiver means 12 without the requirement for bit synchronization  
30 employed in most synchronization systems. The "block" decoder also provides the ability to synchronize on either the non-inverted or inverted synchronization word. In addition, the nine bits of comma 306 allow for timing differences between first  
35 receiver means 16 and second receiver means 22

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clocks. In the preferred embodiment of the present invention, this timing difference is approximately plus or minus four and one-half bits for a system clock stability of 120 ppm over time interval 304.

5       Following synchronization signal 302 is a sixty four bit data block 310, shown in FIG. 3B, consisting of a forty-eight bit data field 314, an eight bit message number 318, a single message continuation bit 318, and a seven bit check block 10       320. Depending upon the type of data message transmitted, it will be appreciated that data field 314, as described consisting of forty-eight bits, may contain different data formats, such as twelve 15       four bit BCD blocks for numeric only characters, or six eight bit ASCII blocks for alphanumeric characters. Because of the short distance for transmission between first receiver means 16 and second receiver means 22, and the ability to retransmit a message if it is corrupted in 20       transmission, the data message is transmitted without any special error correction. As will be described in detail shortly, a check block 320 is provided which can indicate when a message is corrupted, and should be retransmitted.

25       Since first memory means 212 is capable of storing multiple data messages, message number 316, shown in FIG. 3B, is used to identify the number of the currently displayed data message. This 30       information is useful for a variety of reasons, such as an indicator of a missed or unread message when the number changes by two or more since the last received data message. Message number 316 also indicates when first memory means 212 "rolls over", and new messages begin overwriting the earliest 35       previous messages. Message number 316 also ensures

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to the user that messages which are longer than a single display due to a continuation are combined to a single data message.

5 Message continuation bit 318, shown in FIG. 3B, is included to identify data messages transmitted which are longer than twelve numeric characters, or six alphanumeric characters, as previously described. In the preferred embodiment of the present invention, message continuation bit 318 is a  
10 "0" when data message continuation is not required, and a "1" when a message continuation will occur. It will be appreciated, multiple continuations of a data message can be allowed, limited only by the amount of memory provided to store the incoming data  
15 messages. When data messages are longer than one data block in length, a second time interval 322 is provided between data blocks. This time interval allows time to verify the previous data block was transmitted correctly and stored before the next  
20 data block is received. It will be appreciated, the length of time interval 322 is a matter of design choice, and depending upon operation may not be required.

Check character 320, shown in FIG. 3B, provides  
25 an overall check of data block 310. Check character 320 provides a convenient means of indicating data messages transmitted between first receiver means 16 and second receiver means 22 have not been corrupted in transmission. As messages are received, second  
30 receiver means computes the value of check character 320. If this value does not match the transmitted value of check character 320 the data message transmitted has been corrupted, and an error message is presented on the display of second receiver means  
35 22, indicating to the user that he should actuate

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the TRANSMIT switch on first receiver means 16 retransmitting the received data message.

It will be appreciated by one skilled in the art that the size of data block 310, the size of data field 314, the size and format of message number 316, and the size and format of check block 320 are a matter of design choice. Consequently, changes in the size of any of the blocks to allow more or less characters to be transmitted, and changes to the format of the transmission of the information, may be made without departing from the scope or spirit of the preferred embodiment of the present invention.

Reference is now directed to FIG. 4 which shows the preferred embodiment of the apparatus 400 utilizing a microcomputer implementation for first receiver means 16. Antenna 202 and receiver 204, corresponding to first receiver section 204 of FIG. 2, receives and detects data messages transmitted on first communications channel 14. The output of receiver 204 connects to message storage means 206 which consists of storage controller means or microcomputer 208, identification means or code plug 210 for storing addresses and first memory means or RAM 212 for storing data messages.

Microcomputer 208 is a single chip microcomputer, such as the MC68HC05L6 manufactured by Motorola. Microcomputer 208 includes a CPU 436 for operational control. An internal bus 430 connects all the elements of microcomputer 208. I/O port 442 (shown split in the figure) provides communications to the circuits external to microcomputer 208. A Timer Counter 432 is used to generate timing intervals, such as required for battery saver operation on the first communications

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channel, or synchronization signal generation. Oscillator 434 provides the reference frequency for operation of CPU 436. RAM 212 is used as temporary storage of program variables, and also provides  
5 storage for the received data messages. It will be appreciated by those skilled in the art that additional RAM, external to the microcomputer, may be added to provide additional message storage space. ROM 440 contains the firmware controlling  
10 microprocessor 436 operation. Programs, such as for decoding, battery saver operation, synchronization signal generation and message transmission, are stored in ROM 44. An alert generator 438 provides the alerting signal in response to decoding the  
15 address information.

Power for the apparatus 400 is provided by a single cell battery 460. An ON/OFF switch 450, corresponding to part of first switch means 216 of FIG. 2, allows the user to turn power on and off to  
20 the unit. A voltage converter 462 steps up the output voltage from battery 460 to a voltage level sufficient to power microcomputer 208, such as 3.0 volts. Any other circuit elements which may require the higher operating voltage are also supplied from  
25 the output of voltage converter 462. It will be appreciated that while the preferred embodiment only operates from a single battery, multiple batteries could be provided, which would also eliminate the need for voltage converter 462.

30 As shown in FIG. 4, first switch means 216 further comprises a manually actuatable RESET switch 454 and a TRANSMIT switch 452. A switch interface 448 provides the electronics necessary to couple the switches to I/O bus 442. RESET switch 454 allows  
35 manual reset of the sensible alert generated after a

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message has been received and prior to an automatic time out period, such as eight seconds. If the pager is capable of receiving voice messages, RESET switch 454 can also be used to monitor the first communications channel.

TRANSMIT switch 452 allows a data message which has been stored in RAM 212 memory to be retransmitted over the second communications channel. A single actuation of TRANSMIT switch 254 allows transmitting the current message, and repeated actuations thereafter allow transmitting previously received messages as well.

As will be described in detail shortly, there will be times when synchronization between the two units must be restored. When this is required, the user by actuating and holding RESET switch 454 and then momentarily actuating TRANSMIT switch 452 places the pager into the sync or channel acquisition mode, required to initialize synchronization between the two units.

Annunciator means 214 is shown to comprise transducer driver 456 and transducer 458. In response to a data message being received, alert generator 438 generates an audible alert frequency, such as 3 KHz. The output of alert generator 438 couples to transducer driver 456 as well as an output from I/O port 442. I/O port 442 controls the delivery of the alerting signal providing such functions as silent alert operation, i.e. inhibiting the delivery of the alerting signal, and an interrupted alert signal output. The alerting signal is delivered to the user by transducer 458.

Data messages that have been received and stored are transmitted over second communications channel 14 by first transmitter means 218 which is

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comprised of a modulator 444 and a transmitter 446. Depending upon the format of second communications channel 14, transmitter 446 may deliver the signal to an antenna, as in the case of a radio frequency transmission; a transducer, as in the case of an ultrasonic transmission; or a light emitting diode, as in the cases of an infrared transmission.

Microcomputer 208 controls battery saving operation in a manner well known to one skilled in the art by periodically generating a control signal delivered from I/O 442 to battery saver circuit 220. Battery saver circuit 220, in turn, controls the supply of power to receiver section 204, thereby minimizing the power consumption.

Reference is now directed to FIG. 5 which shows the apparatus 500 corresponding to second receiver means 22 which is implemented using a microprocessor. The messages transmitted over second communications channel 20 are received by receiver 222, corresponding to second receiver means 222 of FIG. 2. The output of receiver 222 of FIG. 5 is a serial stream of information corresponding to the serially transmitted data message. The output of receiver 222 couples to I/O port 502 of microcomputer 224, which corresponds to second controller means 224 of FIG. 2. Microcomputer 224 is a single chip microcomputer, such as the MC68HC05L6 manufactured by Motorola. Microcomputer 224 includes a CPU 504 for operational control. An internal bus 518 connects all the elements of microcomputer 224. I/O port 502 (shown split in the figure) provides communications to the circuits external to microcomputer 224. A Timer Counter 516 is used to generate timing intervals, such as

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required for synchronization with first receiver means 16.

Oscillator 514 provides the reference frequency for operation of CPU 504. The oscillator frequency is established by an externally connected crystal (not shown). Depending upon the frequency of operation desired, the oscillator frequency may be derived from an output of a real time clock (RTC) 234, thus requiring only a single crystal for both RTC 234 and CPU 504.

RAM A 226 is used as temporary storage of program variables, and also provides storage for the received data messages. It will be appreciated by those skilled in the art that additional RAM, external to microcomputer 224, may be added to provide additional message storage space. ROM A 508 contains the firmware controlling microprocessor 224 operation. Programs, such as for synchronization, message reception, check character calculation and message presentation are stored in ROM A 508. An alert generator 512 provides the alerting signal in response to receiving a complete data message over second communications channel 14.

Power for apparatus 500 is provided by a single cell battery 532. A voltage converter 530 steps up the output voltage from battery 532 to a voltage level sufficient to power microcomputer 224 such as 3.0 volts. Any other circuit elements which may require the higher operating voltage are also supplied from the output of voltage converter 530. It will be appreciated that while the preferred embodiment only operates from a single battery, multiple batteries could be provided, which would also eliminate the need for voltage converter 530.



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Synchronization circuit 236 couples to receiver section 222 controlling the power delivered to receiver section 222. Microcomputer 224, through I/O 502 controls when synchronization circuit 236  
5 delivers power to receiver section 222. Power is delivered, as previously described, during the time the synchronization signal is present, and further when data messages are being transmitted.

As shown in FIG. 5, second switch means 228  
10 comprises a manually actuatable SET switch 524 and a MODE/HOLD switch 526, and an ADJ/READ switch 528. Switches 524, 526 and 528 couple to I/O port 502.

Annunciator means 232 is shown to comprise transducer driver 520 and transducer 522. In  
15 response to a data message being received, alert generator 512 generates an audible alert frequency, such as 3 KHz. The output of alert generator 512 couples to transducer driver 520 as well as an output from I/O port 502. I/O port 502 controls the  
20 delivery of the alerting signal providing such functions as silent alert operation, i.e. inhibiting the delivery of the alerting signal, and an interrupted alert signal output. The alerting signal is delivered to the user by transducer 522.

25 Data messages that have been received over second communications channel 14 and stored in RAM A 226, as previously described, can be retrieved for review by actuating ADJ/READ switch 528. The messages are displayed on LCD display 230 which  
30 corresponds to presentation means 230 of FIG. 2. When a message is displayed, timer counter 516 is set to a time interval, such as eight seconds, during which the displayed message may be viewed. Upon completion of the eight second interval, the  
35 time would again be displayed. If the user requires

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a longer time interval to view the message, MODE/HOLD switch 526 can be actuated indefinitely freezing the display until MODE/HOLD switch 526 is again actuated.

5       As previously described, RAM A 226 stores the received messages. In the preferred embodiment of the present invention, only the most current message is stored and viewable in the manner just described. It will be appreciated by those skilled in the art, 10 that multiple messages can be stored as well, and recalled for display individually using multiple actuations of ADJ/Read switch 528.

Also connected to I/O port 502 is real-time clock (RTC) 234, such as the MC146818, manufactured 15 by Motorola, provides all the timing functions for the presentation unit. RTC 234 corresponds to time generating means 234 of FIG. 2. When messages are not being displayed, CPU 504 controls the display of time information, such as day and date, on LCD 20 display 230. SET switch 524 allows the time information to be set, or changed. MODE/HOLD switch 526 selects which time information is to be changed, such as hours, minutes, day or date information. ADJ/READ switch 528 allows the information selected 25 by MODE/HOLD switch 526 to be incremented until the desired information is displayed.

Reference is now directed to FIG. 6 which shows a pictorial view of the wrist worn presentation unit 600 corresponding to the presentation unit 22 of 30 FIG. 1. As shown, presentation unit 600 consists of a housing 602 which may be attached to the wrist by a wristband or strap (not shown). Housing 602 is constructed using methods and materials well known to one skilled in the art, such as injection molded 35 plastic, although other materials may be used

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equally as well. Access to the electronics is through a metal cover (not shown), such as plated sheet-metal or stainless steel attached by screws (not shown) or other suitable fasteners to housing  
5 602.

A display area 604 is provided for viewing either a time or message display. FIG. 6 particularly shows a message display 612 consisting of two lines, one of which displays an area code,  
10 and one of which displays the phone number. It will be appreciated by those skilled in the art that all the displayed information may be placed on a single line, or that multiple lines of information may be provided allowing for the display of longer messages  
15 which may also include alphanumeric information. Message number indicator 622 provides a visual indication of the message currently being displayed. This number corresponds to the message number stored in the pager memory. Depending upon the size of the  
20 memory in the presentation unit as compared to the pager, this number could correspond to the message number as stored in the presentation unit as well.

Switches 606, 608 and 610 provide control of the time and message display functions.  
25 Annunciators 614, 616, 618 and 620 are provided which indicate the status of the various functions provided by presentation unit 600, in addition to the time or message display 612. A detailed description of the time and message display  
30 functions and annunciators will be provided shortly.

The display used in presentation unit 600 is preferably an LCD display which provides low current operation and allows convenient time, message and annunciator displays. As with similar wrist worn

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devices, a light function may be provided for viewing the display in the dark.

Reference is now directed to FIG. 7 which describes the annunciator functions. As previously  
5 described, each annunciator actually consists of several graphic indicators, i.e. a bar and a triangle. It will be appreciated other forms of the indicators, such as other graphics or text, may be used without departing from the scope or spirit of  
10 the present invention.

When the presentation unit is synchronized with the pager, triangular CHANNEL indicator 614 is visible, as shown in FIG. 7. It will be appreciated that the pager may be turned off during normal  
15 operation, as might happen when the user turns the pager off each evening; or the battery in the pager could discharge to the point where the transmitter no longer transmits the synchronization signal; or the output of the transmitter may be corrupted by an  
20 extraneous signal, preventing the presentation unit from detecting the synchronization signal. When any of these events happen, the presentation unit continues to look for the synchronization signal to which it was previously synchronized for a period of  
25 time. If after a number of attempts to detect the synchronization signal, such as two attempts, the controller stops searching for sync, and triangular CHANNEL indicator 614 will begin to flash as indicated in FIG. 7. The user is also audibly  
30 alerted of the loss of synchronization by a short chirp being generated and delivered by annunciator 232. It will be appreciated by one skilled in the art that the audible chirp could be periodically generated for a period of time so as to insure the  
35 user is aware of the loss of synchronization. The

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time interval could correspond to the normal synchronization interval of sixty seconds, and may be repeated a number of times, such as three times.

When synchronization is lost, the user must  
5 place the presentation unit in the channel acquisition mode, as will be described shortly, to regain synchronization. The channel acquisition mode is indicated by bar CHANNEL indicator 616 being visible and flashing in addition to triangular  
10 CHANNEL indicator 614, as shown in FIG. 7. Within a short period of time, less than ten seconds, only the triangular CHANNEL indicator 614 will remain visible, indicating synchronization has been successfully completed.

15 If the user purposefully turned off his pager, flashing triangular CHANNEL indicator 614 would act as a reminder to initiate synchronization with the pager, the next time the pager is turned back on. Until then, the presentation unit acts as a  
20 conventional watch, including an alarm feature.

An automatic method of synchronizing the presentation unit to the belt worn unit could be used in place of the manually originated synchronization sequence, and methods for  
25 automatically synchronizing a receiver with a transmitter are well known to those skilled in the art.

However, the manual synchronization method described is provided in lieu of an automatic  
30 synchronization method as there will be times the user will wish to use his presentation unit without the belt worn unit. Also, because of the time duration between synchronization signals, an automatic synchronization method would substantially  
35 impact battery life, unless a means for cancelling

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the synchronization routine is provided, as would be required when the belt worn unit is turned off.

As indicated in FIG. 7, the alarm annunciator operates in a manner well known to those skilled in the art. When the alarm function is not selected, neither ALARM indicator 618 or 620 is visible. When the bar ALARM indicator 620 is visible, the alarm is set.

Reference is now directed to FIG. 8, which shows flow chart 800 indicating the functions controlled by switches 606, 608 and 610. Normally the presentation unit displays time, as shown at block 802. As long as switch S2, corresponding to Set switch 608 is not actuated, as shown at block 804, and switch S1, corresponding to Mode/Hold switch 606 is not actuated, as shown at block 806, time information remains on the display. Actuating switch S2 608, as shown at block 804, places the presentation unit in the time setting routine, as shown at block 808, which provides conventional multiple switch time setting functions. The use of multiple switches to adjust the time of a watch are well known to one skilled in the art. Actuating switch S1 606, as shown at block 806, while the time is being displayed or after the time has been set will cause the alarm time to be displayed, as shown at block 810. Actuating switch S2 608, as shown at block 812, advances the presentation unit to the alarm setting routine, as shown at block 818; which provides conventional multiple switch alarm time setting functions. The use of multiple switches to adjust the alarm time for a watch are well known to one skilled in the art. When alarm set routine, as shown at block 818, is entered, the triangular ALARM indicator 618 becomes visible.

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Actuating switch S3 610, as shown at block 814, activates the alarm function, as shown at block 820, and causes the bar ALARM indicator 620 to become visible. Actuating switch S3 610, as shown at block 814, a second time, causes the alarm to be deactivated, as shown at block 820. Actuating switch S1, as shown at block 816, while the alarm time is being displayed or after the alarm time has been set, or activated, will cause the bar CHANNEL indicator 616 to become visible, as shown at block 822. Actuating switch S2 608, as shown at block 824, advances the presentation unit to the sync acquisition routine, as shown at block 828. The sync acquisition routine will be described in detail with FIG. 9. Actuating switch S1, as shown at block 826, returns the presentation unit to the normal time display mode, as shown at block 802.

Reference is now directed to FIG. 9, which shows flow chart 900 indicating the sync acquisition mode. When the user has entered the sync acquisition mode as previously described in FIG. 8, synchronization means 236 supplies power to receiver 222 (as shown in FIG. 5) continuously, as shown at block 902. Timer/counter 516 is set to a time interval, such as ten seconds, as shown at block 904, which is long enough for the user to actuate and hold RESET (P1) switch 454 and actuate TRANSMIT (P2) switch 452, as shown at block 906. A synchronization signal is then transmitted over the second communications channel, which when detected, as shown at block 908, suspends power to the receiver, as shown at block 911, and resets timer/counter 432 to the sync interval time T1 of sixty seconds, establishing the sync timer, as shown at block 912. The bar CHANNEL indicator 616 is

-30-

turned off and the triangular CHANNEL indicator stops flashing, as shown at block 914, and the unit returns to the time display, as shown at block 916, completing the resynchronization of the two units.

5        If the synchronization signal is not detected, as shown at block 908, within the ten seconds time interval, as shown at block 910, power to the receiver is suspended, as shown at block 917, and an audible chirp is generated, as shown at block  
10    918, indicating the two units failed to synchronize. Triangular CHANNEL indicator 614 will continue to flash as shown at block 920, and the unit will return to the time display, as shown at block 916. The user must reenter the sync acquisition mode, as  
15    previously described, to again attempt to resynchronize the two units.

Reference is now directed to FIG. 10 which shows the signalling format of the Golay Sequential (GSC) Code. The GSC code format is one of a number  
20    of formats in use today to provide the basic communications between the system transmitter operating on the first communications channel and the belt worn pager. Other coding formats, such as the POCSAG signalling format, can be also be used  
25    without departing from the scope or spirit of the present invention.

FIG. 10A shows that data messages are transmitted beginning with an address which identifies the pager to which the message is being  
30    sent, followed by one or more data blocks containing the message information.

As shown in FIG. 10B, addresses used in the GSC signalling format consist of a fourteen bit comma, which is an alternating one/zero pattern transmitted  
35    at twice the bit rate of the address information.



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Following the comma are two Golay words, a word 1 and a word 2, separated by a half bit space. Each Golay word consists of twelve information bits followed by eleven parity bits, as shown in FIG. 10C for a total of twenty-three bits. The Golay word 1's are selected from a group of fifty binary words and their complements, for a total of one hundred unique word 1's. Likewise, the Golay word 2's are selected from a different group of 2048 binary words and their complements, for a total of 4096 unique word 2's.

As shown in FIG. 10D, the format of the data block following the Golay address consists of a half bit space followed by eight data words encoded in a 15,7 BCH format. The length of the data block is the same as a Golay address, allowing simple interleaving of address and data information.

Up to now the communications on the second communications channel between the belt worn pager and separate presentation unit has been described in detail, considering only the situation involving a single user and further considering the transmissions to, in effect, be identical to, but delayed from, the first communications channel. Several problems can occur when multiple users are in close proximity to each other, as shown in FIG. 11. The two users are represented by receiver 1102 which normally communicates to presentation unit 1104 over second communications channel 1106, and receiver 1108 which normally communicates to presentation unit 1110 over second communications channel 1112, as shown in FIG. 11A. Both receivers operate on the same first communications channel, however, because they have different addresses assigned to each of them, only those messages

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directed to them are received. Both users also share a common second communications channel or frequency, and as shown, when receiver 1102 transmits the message received over the second communications channel 1106 to presentation unit 1104, presentation unit 1110 can also receive the same message over second communications channel 1114. In general, however, presentation unit 1110 will not receive the message because it is synchronized with receiver 1108, not with receiver 1102. As shown in FIG. 11B, receiver 1102 generates a synchronization pulse 1118 which is 53 msec long once every sixty seconds to which presentation unit 1104 is synchronized. Presentation unit 1104 does not then look at the channel until sixty seconds later for synchronization pulse 1120. Because presentation unit 1110 is synchronized to receiver 1108, and receiver 1108 and receiver 1102 were randomly synchronized as previously described, only the presentation unit synchronized with receiver 1102 would receive the message over the second communications channel. In a large population of receivers and presentation units, chances are approximately 1 in 1000 that the wrong presentation unit will receive a message from another unit. If the oscillators in receiver 1102 and 1108 did not vary over time or temperature, receiver 1102 would always generate a synchronization pulse 1118 which is separated from receiver 1108 synchronization pulse 1122 by  $T_x$  seconds 1126. Since the oscillators are not high stability, over time the synchronization pulses 1128 and 1130 will eventually overlap for a period of time as shown in FIG. 11C. When this happens, presentation unit 1110 may

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receive a message transmitted to presentation unit 1104 by receiver 1102.

When the transmissions overlap as described, the receiver section of presentation unit 1110 can  
5 be captured by the signal generated by the transmitter in receiver 1102. When this occurs, transmissions generated by receiver 1108 to presentation unit 1110 could be interfered with, as both receiver 1102 and receiver 1108 are  
10 simultaneously transmitting on the same frequency, thus creating another problem.

Since users are capable of initiating synchronization of the presentation unit to the belt worn receiver, a user could also attempt to  
15 synchronize his presentation unit to the receiver of another user. When this happens, the security of the messages received by one user on the first communications channel would be compromised because of the common synchronization signal being employed  
20 on the second communications channel.

Reference now is directed to FIG. 12 which shows the secure synchronous signalling format 1200 which is utilized in the preferred embodiment of the present invention to prevent falsing of a  
25 presentation unit either intentionally, or unintentionally. In place of a common synchronization signal shown in FIG. 3, coded synchronization signals, or sync addresses 1202 and 1206 are provided. As shown in FIG. 12, where data  
30 blocks are continued, each data block 1204 is preceded by a sync address 1202. Each presentation unit is programmed to a unique sync address. In the preferred embodiment of the present invention, the sync address 1202 programmed corresponds to the word  
35 2 of the GSC address to which the belt worn receiver

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is programmed. Since there are 4096 word 2's which are randomly assigned in a typical paging system, each presentation unit can be individually programmed with a correspondingly assigned coded sync signal, or sync address. As previously described, the assigned sync address is used to identify transmissions including data, and the inverse sync address identifies a synchronization signal. The sync address insures messages are not received by presentation units in close proximity to another user who has just received a message.

While the sync address provides message security for transmission on the second communications channel, it does not overcome the problem of two receivers transmitting in essentially the same time frame, as previously described in FIG. 11C. When the transmissions overlap, one or both presentation units may miss transmissions due to the receiver being captured by the transmitter of the other unit. If this occurs for more than two frames, which is very likely, the presentation units would lose synchronization and shut down, as previously described. When this happens, it will be appreciated that the transmissions could overlap for a period of time of ten minutes or longer, depending upon the relative stabilities of the oscillators of the two units. This problem can be overcome by randomly assigning different transmission time intervals to different units, such as sixty seconds and sixty seconds plus and minus one second, resulting in transmissions between different unit precessing in time. By staggering the transmission intervals as described, when two units transmissions overlap, it would be only for, at most, a single transmission, rather than for the extended period of

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time possible where only a single fixed length transmission time interval is involved. The assignment of transmission time intervals can be linked to the coded synchronization word or can be completely random. It will be appreciated any system of assigning transmission times cannot guarantee that two units can still experience the interference problem by both being assigned the same transmission time.

Reference is directed back to FIG. 5. RAM B 506 is a specific section of RAM set aside to store the sync address corresponding to the word 2 of the belt worn unit. ROM B 510 is a specific section of ROM set aside to store a common synchronization word which is required to allow the wrist worn presentation unit to be programmed. The programming procedure will be discussed in detail shortly.

It will be appreciated by those skilled in the art, that the concept of the coded synchronization word described for providing the battery saving function on the second communications channel can also be applied to the first communications channel. Synchronous systems, such as POCSAG, have periods of time, especially in the evening and night hours, when very few messages are received for transmission. In the POCSAG signalling format, as shown in FIG. 13, power is supplied to the receiver such that sync code is received, thereby maintaining system synchronization, and for an additional time interval corresponding to one of the following eight frames comprising the batch such as frame 2. In this manner, the battery saving function is provided. FIG. 13B shows the format of a typical POCSAG address, while FIG. 13C shows the format of a typical POCSAG data block. Each frame can consist

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of two addresses or an address followed by a data block. Messages longer than one data block are transmitted continuing into the following frames.

Within the POCSAG signalling format power is  
5 supplied to all receivers during the sync code and the assigned frame. There is no provision for inhibiting the power supplied to the receiver for particular frames. By inhibiting power being  
10 supplied to the receiver during the assigned frame when no addresses are to be transmitted, additional battery saving is obtained. In the preferred embodiment of the present invention, where a synchronous signalling format, such as POCSAG, is used for the first communications channel, a non-  
15 inverted sync code is used to indicate addresses and data messages will be transmitted in the following frames. An inverted sync code indicates no address or data messages are in queue for transmission. As such power need not be supplied during the assigned  
20 frame, until the next expected sync code in the next batch. It will also be appreciated by one skilled in the art that the definition of inverted and non-inverted sync word described above is a matter of choice.

25 When a sync address is provided for communication between the pager and presentation unit, it is most convenient to provide both synchronization of the two units and reprogramming of the sync address in the same operation, thereby  
30 eliminating any confusion on the part of the user, as to whether the sync loss is due to corruption of the synchronization signal causing loss of sync, or loss of sync address in the presentation unit.

When the presentation unit is to be programmed,  
35 both the pager and the presentation unit assigned a

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common sync address that is stored in the ROMs of each units. This common sync address allows the two units to communicate for the programming operation. The unique address to which the pager is programmed, is transmitted to the presentation unit as if it were a data message following the common sync address. Unlike a standard data message which is stored in RAM A and then displayed, the unique address is stored in RAM B of the presentation unit. This becomes the permanent sync address used in communication between the two units. In this manner, resynchronization and reprogramming is easily accomplished. New presentation units are easily programmed to communicate with an existing pager, or new pagers are easily programmed to communicate with existing presentation units. This is especially important where a problem in one of the units is encountered requiring service, a replacement for either unit will work with the remaining unit. When the presentation unit is considered a jewelry item, as may be the case with a female user, a single pager can communicate to wrist worn presentation units, broach or pendant type presentation units, or any other form factor, and be change and resynchronized as often as desired.

Reference is now directed to FIG. 14 which shows flow chart 1400 indicating the modification to the sync acquisition mode, previously described in FIG. 9, which provides programming of the sync address. When the user has entered the sync acquisition mode as previously described in FIG. 8, power switch 236 supplies power to receiver 222 (as shown in FIG. 5) continuously, as shown at block 1402. Timer/counter 516 is set to a time interval, such as ten seconds, as shown at block 1404, which

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is long enough for the user to actuate and hold  
RESET (P1) switch 454 and actuate TRANSMIT (P2)  
switch 452, as shown at block 1406. A  
synchronization signal is then transmitted over the  
5 second communications channel, which when detected,  
as shown at block 1408, suspends power to the  
receiver, as shown at block 1411, and resets  
timer/counter 432 to the sync interval time T1 of  
sixty seconds, establishing the sync timer, as shown  
10 at block 1412. The bar CHANNEL indicator 616 is  
turned off and the triangular CHANNEL indicator  
stops flashing, as shown at block 1414, and the unit  
returns to the time display, as shown at block 1416,  
completing the resynchronization of the two units.

15 If the synchronization signal is not detected,  
as shown at block 1408, within the ten seconds time  
interval, as shown at block 1410, power to the  
receiver is suspended, as shown at block 1417, and  
an audible chirp is generated, as shown at block  
20 1418, indicating the two units failed to  
synchronize. Triangular CHANNEL indicator 614 will  
continue to flash as shown at block 1420, and the  
unit will return to the time display, as shown at  
block 1416. The user must reenter the channel  
25 acquisition mode, as previously described, to again  
attempt to reprogram the presentation unit and  
resynchronize the two units.

An apparatus comprising a belt or pocket worn  
unit and a wrist worn presentation unit has been  
30 described. The belt or pocket worn unit operates on  
a first, or conventional, communications channel and  
provides excellent receiver sensitivity, reliable  
message reception, and good battery life. Messages  
received by the belt or pocket worn unit are stored  
35 within the unit and then retransmitted on a second



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communications channel to a wrist worn presentation unit. When received, the message is stored within the wrist worn unit where it is conveniently displayed. Annunciators in the belt or pocket worn unit and/or the wrist worn presentation unit alert the user of a received message. Switches are provided on the units which allow resetting of the alerts on either or both of the units, retransmission of previously received messages from the belt or pocket worn unit to the wrist worn presentation unit, and review of messages currently stored in the wrist worn presentation unit.

While the description provided has been primarily focused on a simplex transmission between the belt worn unit and the wrist worn presentation unit, it will be appreciated that additional benefit can be obtained if a duplex transmission channel is provided for the second communications channel. A duplex operation is easily achieved by replacing transmitter 218 as shown in FIGS. 2 and 4 with a transceiver and replacing the second receiver section 222 also with a transceiver.

When duplex channel operation is provided, transmissions from the belt worn unit to the wrist worn presentation unit provide data messages, while transmissions from the wrist worn presentation unit to the belt worn unit are for control, such as channel acquisition, and recall of previously received messages, just to name a few. The reliability of communications between the belt worn unit and the wrist worn unit can also greatly be improved as messages received in error by the wrist worn unit can be corrected by an automatic request to retransmit the message. Also, such issues as the time delay encountered in transmitting a previously

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received message from the belt worn unit to the wrist worn presentation unit can be eliminated as the receiver in the presentation unit can be immediately energized without interrupting the previously described synchronization cycles.

With duplex operation, the belt worn unit no longer need be accessible to the user. It can now be worn in a pocket or placed in a purse with only the wrist worn presentation unit being visible. No one need know the user has complete communications as the "pager" is no longer visible.

A coded synchronization system is provided for communications between the belt worn unit and the wrist worn presentation unit. The coded synchronization system provides improved battery life and secure communications. When implemented on the main communications channel, the coded synchronization system can provide improved battery life for the belt worn unit which is a function of the system loading.

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Claims

1. A personal communications device, for presenting to a user messages being transmitted on a first communications channel, said device comprising:

5 first receiver means for receiving and detecting messages being transmitted on the first communications channel;

first transceiver means, coupled to said first receiver means, for transmitting on a second  
10 communications channel, the received messages and for receiving control information;

second transceiver means, separated from said first receiver means, for receiving and detecting the messages transmitted on the second  
15 communications channel and for transmitting control information; and

means, coupled to said second receiver means, for presentation of the messages received on the second communications channel.

20 2. The personal communications device according to claim 1 wherein said first receiver means comprises:

a first receiver section for receiving and detecting messages being transmitted on the first  
25 communications channel; and

message storage means, coupled to said first receiver section, for storing at least one received message.

3. The personal communications device  
30 according to claim 2 wherein the message transmitted on the first communications channel includes a

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selective call address and message information, and wherein said message storage means further comprises:

identification means storing a  
5 predetermined identification address;  
a first memory for storing message  
information; and

storage controller means, coupled to said  
first receiver section and to said identification  
10 means, and further coupled to said first memory, for  
controlling the storage of the received message  
information in said first memory when the received  
selective call address matches the predetermined  
identification address.

15 4. The personal communications device  
according to claim 3 wherein said storage controller  
means further controls the transmission of the  
stored message by said first transceiver means after  
the message has been stored.

20 5. The personal communications device  
according to claim 3 wherein said transceiver means  
generates a carrier signal and modulates the carrier  
signal with the stored message.

6. The personal communications device  
25 according to claim 5 wherein said carrier signal is  
ultrasonic radiation.

7. The personal communications device  
according to claim 5 wherein said carrier signal is  
infrared radiation.

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8. The personal communications device according to claim 30 wherein said carrier signal is radio frequency radiation.

9. The personal communications device  
5 according to claim 1 wherein said second transceiver means comprises:

a second receiver section for receiving and detecting messages being transmitted on the second communications channel;

10 second controller means, coupled to said second receiver section and to said presentation means, for controlling the presentation of the message received on the second communications channel; and

15 a second transmitter section, coupled to said second controller means for transmitting control information.

10. The personal communications device according to claim 9 wherein said second  
20 transceiving means further comprises:

annunciator means, responsive to said second controller means, for generating a sensible alerting signal after the message information is received on the second communications channel; and

25 reset means, coupled to said second controller means, for suspending the generation of the sensible alerting signal.

11. The personal communications device according to claim 10 wherein the sensible alerting  
30 signal is audible.

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12. The personal communications device according to claim 10 wherein said second reset means is a manually actuatable switch.

5 13. The personal communications device according to claim 9 wherein said second transceiver means further comprises a second memory, coupled to said second controller means, for storing the message information received on the second communications channel.

10 14. The personal communications device according to claim 13 further comprising switch means, coupled to said second controller means, for selecting the presentation of the stored message information.

15 15. The personal communications device according to claim 9 wherein said second transceiver means further comprises switch means, coupled to said second controller means, for manually selecting a re-transmission of the stored message information  
20 on the second communications channel.

16. The personal communications device according to claim 10 wherein said second transceiver means further comprises means for generating time signals coupled to said second controller means, and wherein said second controller means being responsive to said time generating means for selectively presenting the time signals when message information is not presented.

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17. The personal communications device according to claim 16 wherein the presentation of time and message information is visual.

5 18. The personal communications device according to claim 1 wherein said first receiver means is worn on the body and further wherein said second transceiver means is worn on the body.

10 19. The personal communications device according to claim 18 wherein said second transceiver means is worn on the wrist.

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20. A method for providing the battery saving function for a battery powered personal communications receiver operating in a communications system transmitting first  
5 synchronization signals followed by coded message signals, the communications receiver having a receiver section for receiving and detecting the transmitted first synchronization signals and coded  
10 message signals, and a controller for periodically controlling the supply of power to the receiver section for enabling the receiving and detecting of the first synchronization signals and coded message signals, said method comprising the steps of:  
generating a second synchronization signal  
15 in place of the first synchronization signal when coded message signals are not to be transmitted;  
receiving, detecting and processing the second synchronization signal; and  
suspending the supply of power to the  
20 receiver section immediately following the processing of the second synchronization signal,  
whereby the supply of power to the receiver section is suspended during the additional  
time interval coded message signals are not to be  
25 transmitted.

21. The method according to claim 20 wherein the first and second synchronization signals are coded binary information.

22. The method according to claim 21 wherein  
30 the second synchronization signal is the complement of the first synchronization signal.



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23. A system for providing the battery saving function for a battery powered personal communications receiver operating in a communications system transmitting first
- 5       synchronization signals followed by coded message signals, the communications receiver having a receiver section for receiving and detecting the transmitted first synchronization signals and coded
- 10       message signals, and a controller for periodically controlling the supply of power to the receiver section for enabling the receiving and detecting of the first synchronization signals and coded message signals, said system comprising:
- transmitter means;
- 15       sync generating means, coupled to said transmitting means, for generating a second synchronization signal in place of the first synchronization signal when coded message signals are not to be transmitted;
- 20       battery powered receiver means for receiving and detecting the transmitted synchronization signals and coded message signals; and
- controller means, coupled to said receiver
- 25       means, for suspending the supply of power to said receiver means following the detection of the second synchronization signal.

24. The system for transmitting messages according to claim 23 wherein the first and second
- 30       synchronization signals are coded binary information.

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25. The system for transmitting messages according to claim 24 wherein the second synchronization signal is the complement of the first synchronization signal.

-49-

26. A personal communications device including a receiver for receiving and detecting coded message signals, including selective call signalling and message information, being transmitted on a first communication channel, an address memory for storing predetermined address information, and a controller, coupled to the receiver and to the address memory, and responsive to the selective call signalling for effecting the storage of the message information, said device further comprising:

sync generating means, coupled to the address memory, for periodically generating coded synchronization signals corresponding to the predetermined address information;

transmitter means, coupled to said sync generating means for transmitting on a second communications channel the coded synchronization signals;

second receiver means, separate from the receiver, for receiving and detecting the coded synchronization signals transmitted on the second communications channel;

second memory means for storing address information corresponding to the predetermined address information; and

second controller means, coupled to said second receiver means and to said second memory means and responsive to the detected coded synchronization signals, for supplying power to said second receiver means in synchronism with the transmitted coded synchronization signals on the second communications channel.

-50-

27. The personal communications device according to claim 26 wherein said sync generating means generates first and second coded synchronization signals and further is coupled to the controller and responsive to the receipt of message information, said sync generating means generating the first coded synchronization signal, at least once, in place of the second coded synchronization signal when message information is received.

28. The personal communications device according to claim 27 wherein said second coded synchronization signal is the complement of the first coded synchronization signal.

29. The personal communications device according to claim 28 wherein said transmitter means further couples to the controller, and wherein said transmitter means transmits the received message information following the transmission of the first coded synchronization signal.

30. The personal communications device according to claim 29 wherein said second controller means is responsive to the first and second coded synchronization signals, said second controller means controlling the supply of power to said second receiver means for an additional predetermined time interval in response to the first coded synchronization signal being detected during which time the message information transmitted on the second communications channel is received.

## AMENDED CLAIMS

[received by the International Bureau on 30 August 1988 (30.08.88)  
original claims 1-30 replaced by amended claims 1-30 (11 pages)]

1. A personal message receiving apparatus, for presenting to a user selective call messages, having selective call address and message information, being transmitted on a first radio frequency communications channel, said apparatus comprising:

a portable communications receiver (16) intended to be carried by the user, said receiver having,

a first receiver portion (202, 204) for receiving and detecting the selective call address and message information being transmitted on the first radio frequency communications channel,

message storage means (206) responsive to the detected selective call address information for effecting the storing of the received message information, and

transmitter means (218), coupled to said message storage means (206), and further responsive to the message information being stored for subsequently transmitting on a second communications channel, the stored message information;

a presentation unit (22) further intended to be carried by the user, said unit having,

a second receiver means (222), separate from said portable communications receiver (16), for receiving and detecting the message information transmitted on the second communications channel, and

presentation means (230), coupled to said second receiver means, for presenting the message information received on the second communications channel.

2. The personal message receiving apparatus, according to claim 1 wherein said message storage means (206) is capable of storing a plurality of messages.

3. The personal message receiving apparatus, according to claim 1 wherein said message storage means (206) further comprises:

identification means (210) storing a predetermined identification address;

a first memory (212) for storing message information; and

storage controller means (208), coupled to said first receiver portion (204) and to said identification means (210), and further coupled to said first memory (212), for controlling the storage of the received message information in said first memory (212) when the received selective call address matches the predetermined identification address.

4. The personal message receiving apparatus, according to claim 3 wherein said storage controller means (206) further controls the subsequent transmission of the stored message information by said transmitter means (218) after the message has been stored.

5. The personal message receiving apparatus, according to claim 3 wherein said transmitter means (218) generates a carrier signal and modulates the carrier signal with the stored message.

6. The personal message receiving apparatus, according to claim 5 wherein said carrier signal is ultrasonic radiation.

7. The personal message receiving apparatus, according to claim 5 wherein said carrier signal is infrared radiation.

8. The personal message receiving apparatus, according to claim 5 wherein said carrier signal is radio frequency radiation.

9. The personal message receiving apparatus, according to claim 1 wherein said presentation unit (22) comprises:

a second receiver section (222) for receiving and detecting messages being transmitted on the second communications channel; and

second controller means (224), coupled to said second receiver section and to said presentation means, for controlling the presentation of the message received on the second communications channel.

10. The personal message receiving apparatus, according to claim 9 wherein said presentation unit (22) further comprises:

annunciator means (232), responsive to said second controller means, for generating a sensible alerting signal after the message information is received on the second communications channel; and

reset means (228), coupled to said second controller means (224), for suspending the generation of the sensible alerting signal.

11. The personal message receiving apparatus, according to claim 10 wherein the sensible alerting signal is audible.

12. The personal message receiving apparatus, according to claim 10 wherein said reset means (228) is a manually actuatable switch.

13. The personal message receiving apparatus, according to claim 9 wherein said presentation unit (22) further comprises a second memory (226), coupled to said second controller means (224), for storing the message information received on the second communications channel.

14. The personal message receiving apparatus, according to claim 13 further comprising switch means (228), coupled to said second controller means (224), for selecting the presentation of the stored message information.

15. The personal message receiving portable communications apparatus, according to claim 4 wherein said portable communication receiver (16) further comprises switch means (216), coupled to said storage controller means (208), for manually selecting a re-transmission of the stored message information on the second communications channel.

16. The personal message receiving apparatus, according to claim 10 wherein said presentation unit (22) further comprises means for generating time signals coupled to said second controller means (224), and wherein said second controller means



(224) being responsive to said time generating means (234) for selectively presenting the time signals when message information is not presented.

17. The personal message receiving apparatus, according to claim 16 wherein the presentation of time and message information is visual.

18. The personal message receiving apparatus, according to claim 1 wherein said presentation unit (22) is intended to be worn on the wrist.

19. A method for providing an improved battery saving function for a battery powered personal communications receiver, the receiver normally being powered during a first periodically transmitted predetermined time interval for receiving synchronization signals, and during at least one of a plurality of additional predetermined time intervals to which the receiver is assigned following the synchronization signal, for receiving coded message signals, said method comprising the steps of:

generating and transmitting a first coded synchronization signal when coded message signals are to be transmitted in at least one of the plurality of additional time intervals;

generating and transmitting a second coded synchronization signal in place of the first synchronization signal when coded message signals are not to be transmitted in any of the plurality of additional time intervals;

maintaining receiver synchronization with the system when either the first or the second coded synchronization signals are received; and

suspending the supply of power to the receiver immediately following the receipt the second synchronization signal,

whereby the supply of power to the receiver is suspended during the additional time interval coded message signals are not to be transmitted.

20. The method according to claim 19 wherein the first and second synchronization signals are coded binary information.

21. The method according to claim 20 wherein the second synchronization signal is the complement of the first synchronization signal.

22. A system providing an improved battery saving function for a personal communications receiver, the receiver normally being powered during a first periodically transmitted predetermined time interval for receiving synchronization signals, and during at least one of a plurality of additional predetermined time intervals to which the receiver is assigned following the synchronization signal, for receiving coded message signals, said system comprising:

sync generating means (208), periodically generating the synchronization signals, the synchronization signals being coded, said sync generating means generating a first coded synchronization signal when coded message signals are to be transmitted in at least one of the plurality of additional time intervals, said sync generating means further generating a second coded synchronization signal in place of said first synchronization signal when coded message signals are not to be transmitted in any of the plurality of additional time intervals;

transmitter means (218), coupled to said sync generating means, for transmitting the coded synchronization and coded message signals;

battery powered receiver means (222) for receiving and detecting the transmitted coded synchronization and coded message signals; and

controller means (224, 236), responsive to said received coded synchronization signals for maintaining receiver synchronization, said controller means supplying power to said receiver means (222) for the additional time interval for receiving coded message signals when the first synchronization signal is received, and suspending

the supply of power to said receiver means (222) for the additional time interval when the second synchronization signal is received.

23. The system for transmitting messages according to claim 22 wherein the first and second synchronization signals are coded binary information.

24. The system for transmitting messages according to claim 23 wherein the second synchronization signal is the complement of the first synchronization signal.

25. A transmitter for providing an improved battery saving function for a personal communications receiver, the receiver normally being powered during a first periodically transmitted predetermined time interval for receiving synchronization signals, and during at least one of a plurality of additional predetermined time intervals to which the receiver is assigned following the synchronization signal, for receiving coded message signals, said transmitter comprising:

sync generating means (208), periodically generating the synchronization signals, the synchronization signals being coded, said sync generating means generating a first coded synchronization signal when coded message signals are to be transmitted in at least one of the plurality of additional time intervals, said sync generating means further generating a second coded synchronization signal in place of said first synchronization signal when coded message signals are not to be transmitted in any of the plurality of additional time intervals;

transmitter means (218), coupled to said sync generating means, for transmitting the coded synchronization and coded message signals;

26. The transmitter of claim 25 wherein the first and second coded synchronization signals are coded binary information.

27. The transmitter of claim 26 wherein the first coded synchronization signal is the complement of the second coded synchronization signal.

28. A personal communications receiver having an improved battery saving function, the receiver normally being powered during a first periodically transmitted predetermined time interval for receiving synchronization signals, and during at least one of a plurality of additional predetermined time intervals to which the receiver is assigned following the synchronization signal, for receiving coded message signals, the receiver comprising:

battery powered receiver means (204 or 222) for receiving and detecting the transmitted coded synchronization and coded message signals; and

controller means (208, 220 or 224, 236), responsive to said received coded synchronization signals for maintaining receiver synchronization, said controller means supplying power to said receiver means (204 or 222) for the additional time interval for receiving coded message signals when the first synchronization signal is received, and suspending the supply of power to said receiver means (204 or 222) for the additional time interval when the second synchronization signal is received.

29. The receiver of claim 28 wherein the first and second coded synchronization signals are coded binary information.

30. The receiver of claim 29 wherein the first coded synchronization signal is the complement of the second coded synchronization signal.

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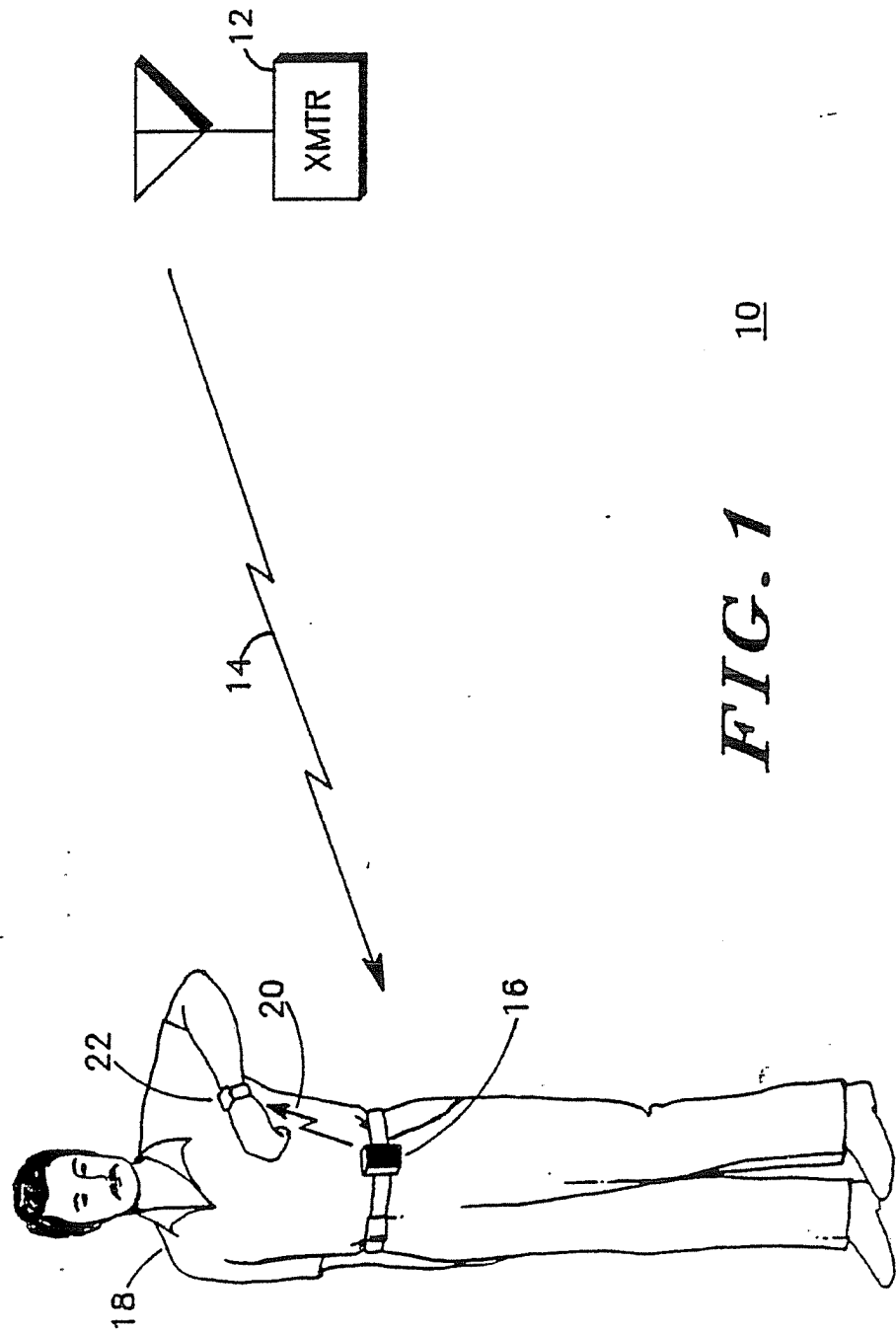
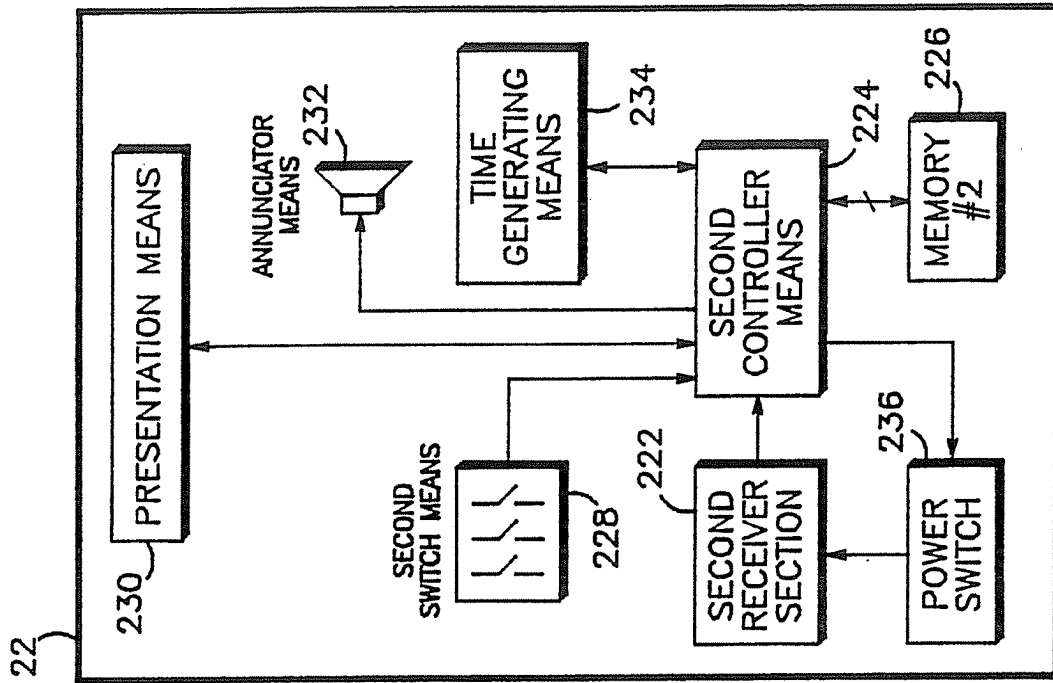


FIG. 1

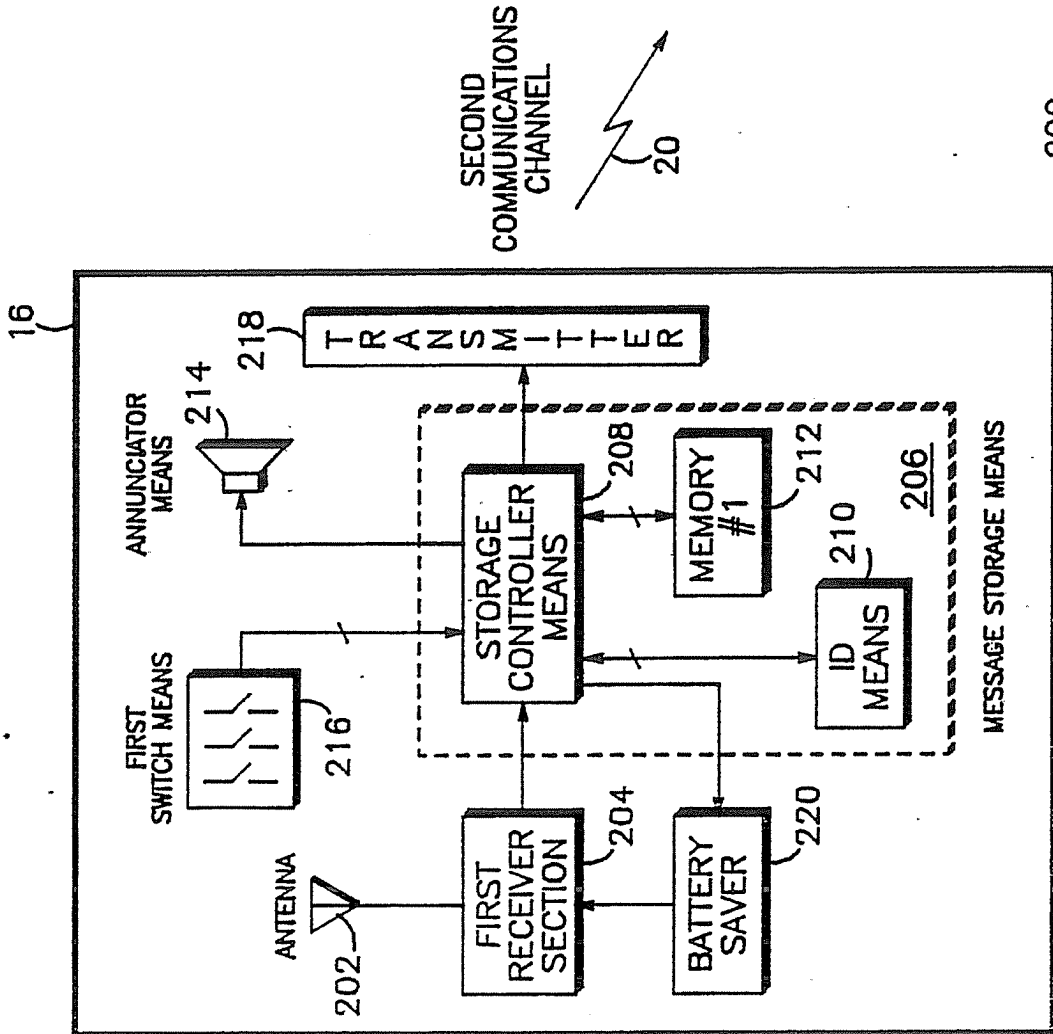
10



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SECOND RECEIVER MEANS



FIRST RECEIVER MEANS

FIG. 2

200

SECOND COMMUNICATIONS CHANNEL

20

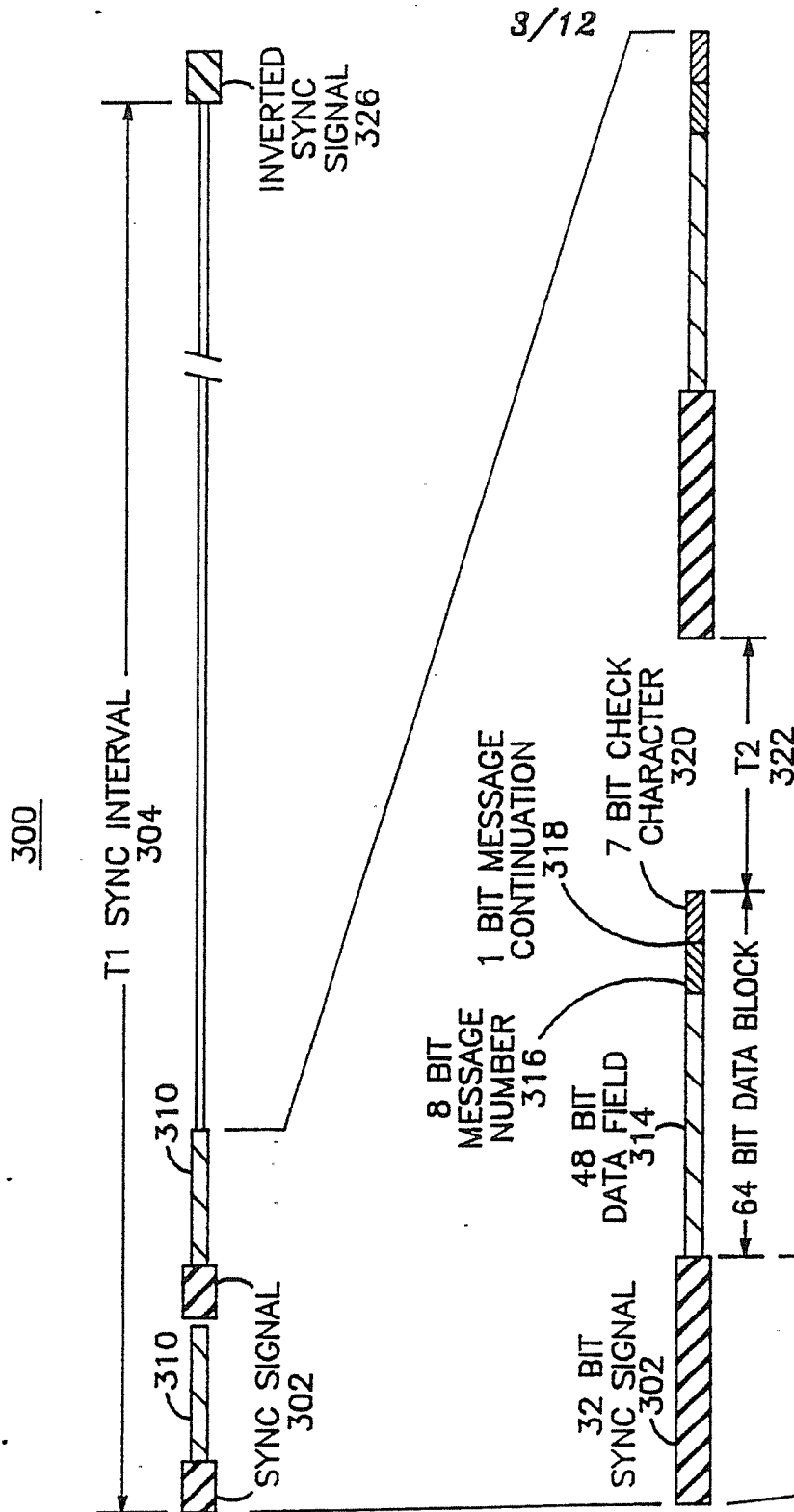
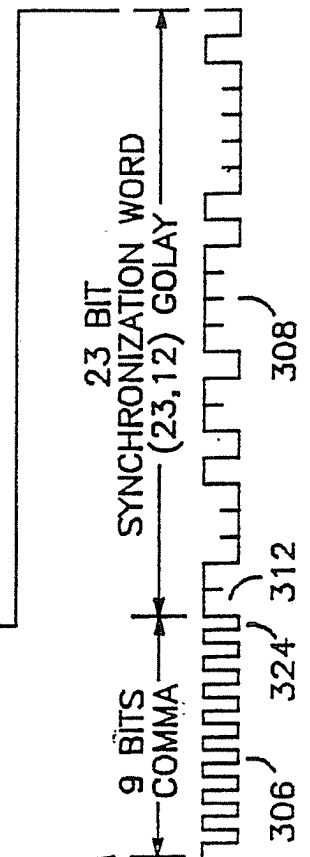


FIG.  
3A

FIG.  
3B

FIG.  
3C



FIRST COMMUNICATIONS CHANNEL 14

ANTENNA 202

B+

BATTERY SAVER 220

RECEIVER SECTION 204

B++

206

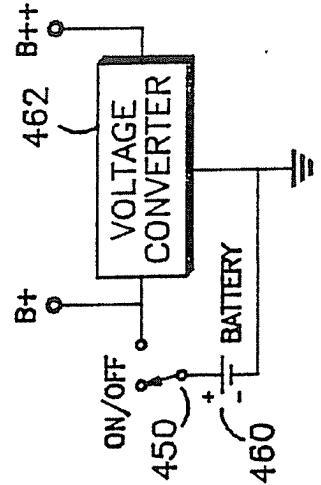
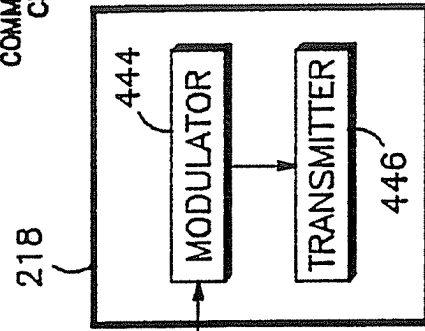
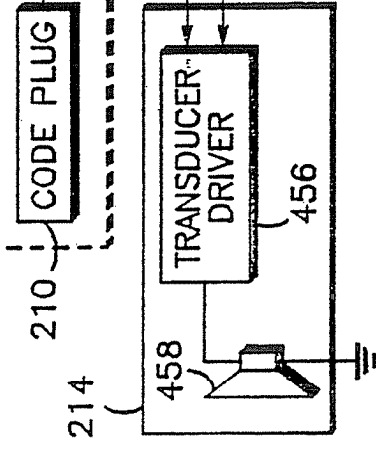
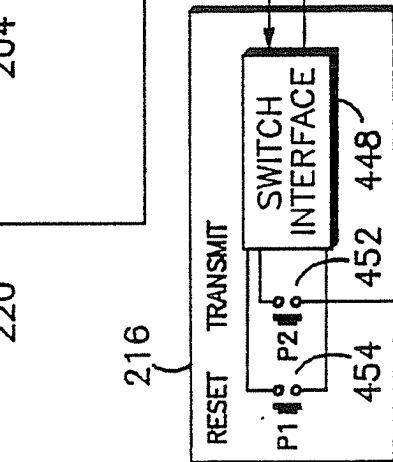
208

FIG. 4

400

SECOND COMMUNICATIONS CHANNEL 20

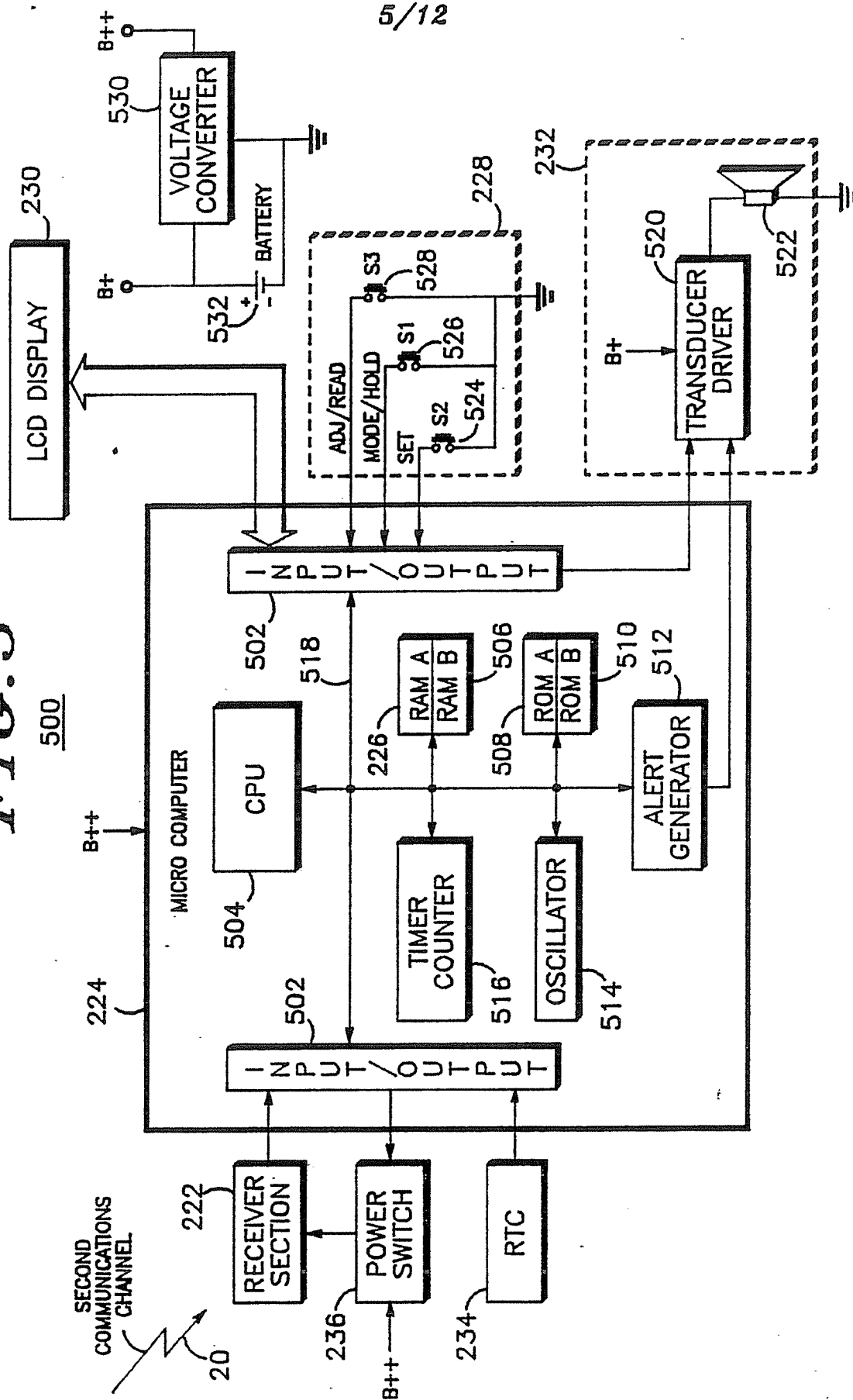
4/12



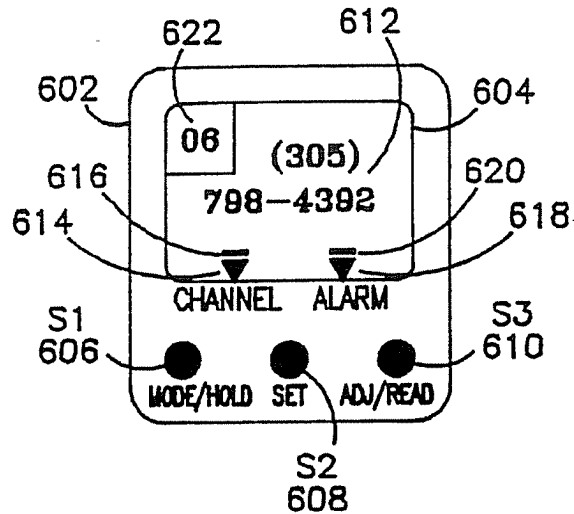
5/12

FIG. 5





500



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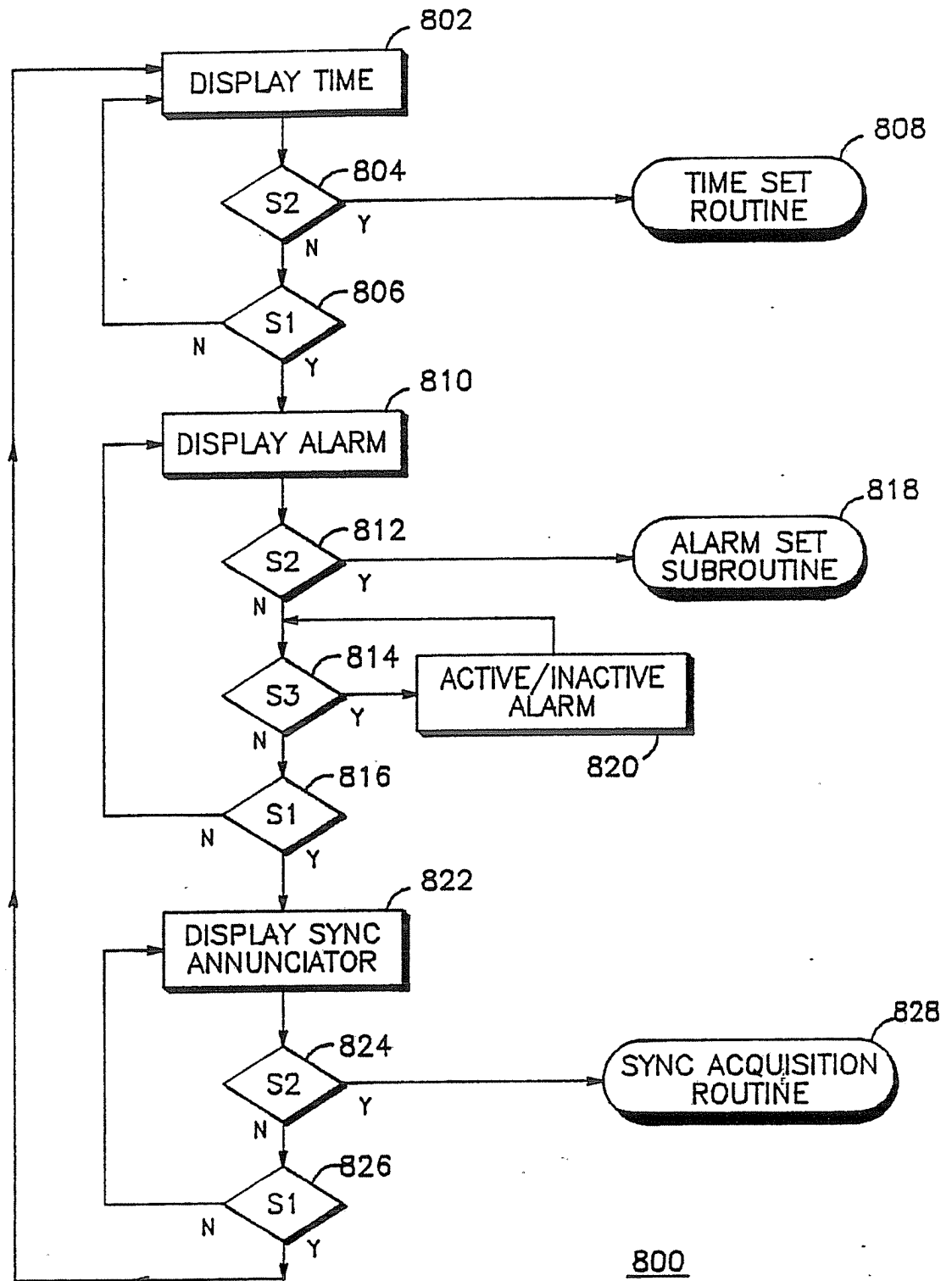
600**FIG. 6**

ANNUNCIATOR DEFINITION TABLE

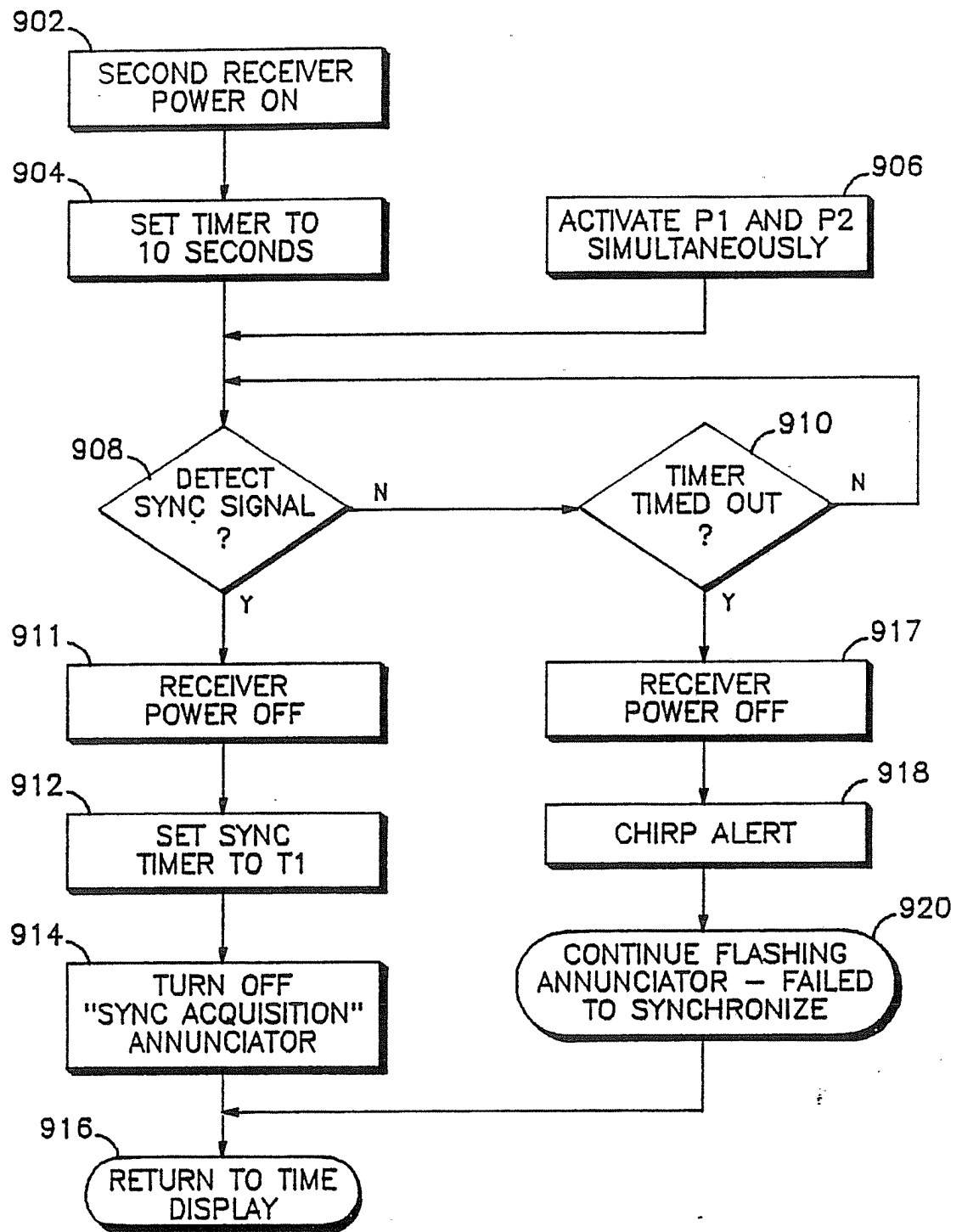
CHANNEL	DESCRIPTION
 (SOLID)	THE CHANNEL IS OPERATING PROPERLY, THE SECONDARY UNIT IS RECEIVING SIGNALS FROM THE PRIMARY UNIT.
 (FLASHING)	THE SECONDARY IS NOT RECEIVING SIGNALS FROM THE PRIMARY UNIT, THE USER MUST RE-ESTABLISH THE CHANNEL.
 (FLASHING)	THE SECONDARY UNIT IS IN THE CHANNEL RE-SET MODE AND IS WAITING TO RECEIVE A SIGNAL FROM THE PRIMARY UNIT.
ALARM	DESCRIPTION
	THE ALARM ANNUNCIATORS OPERATE THE SAME AS IN PRESENT WATCHES. THE BOTTOM ANNUNCIATOR INDICATES THAT AN ALARM HAS BEEN SET AND A FLASHING TOP ANNUNCIATOR INDICATES THAT THE UNIT IS IN THE ALARM SET MODE.

**FIG. 7**

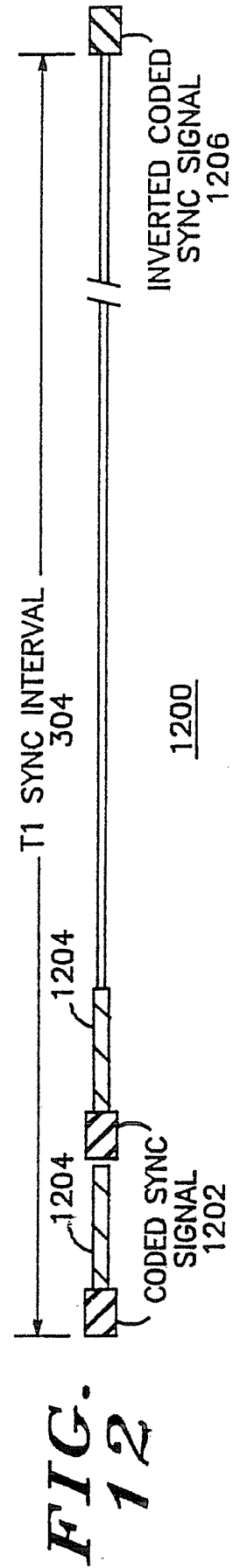
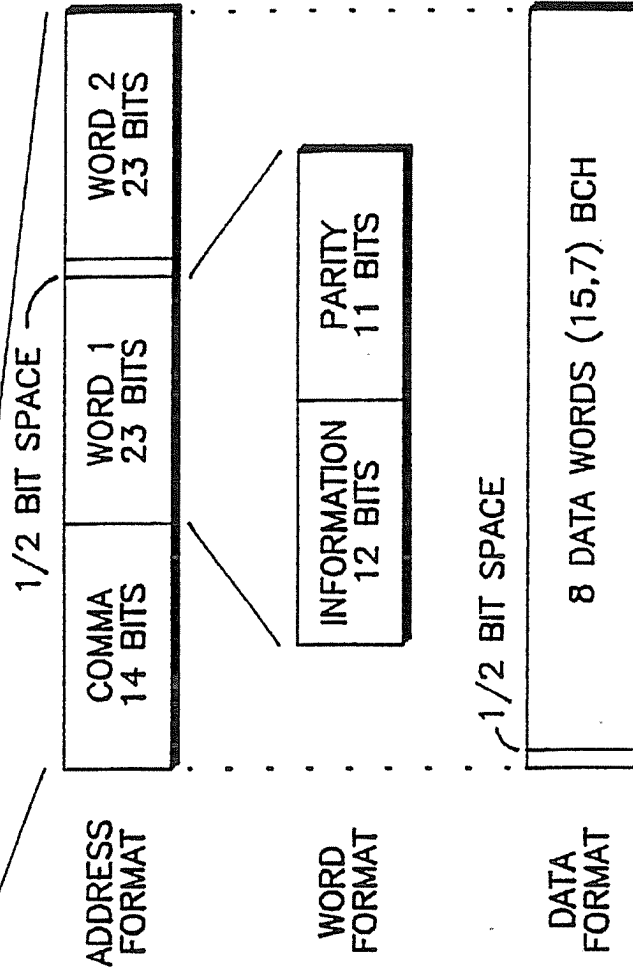
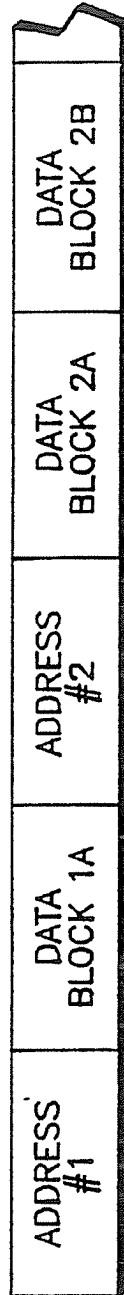
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**FIG. 8**

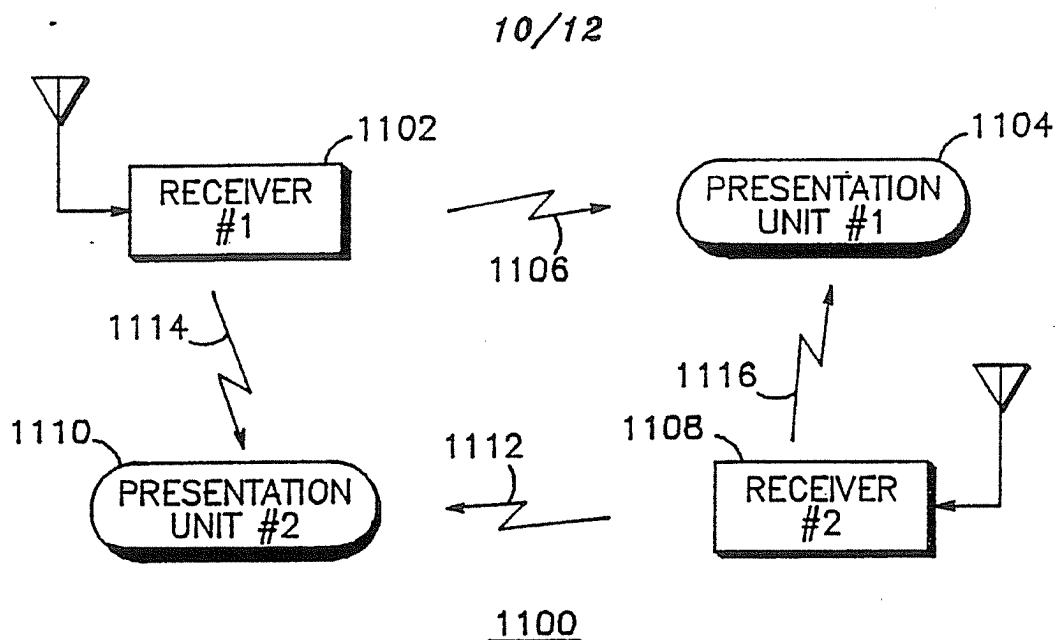
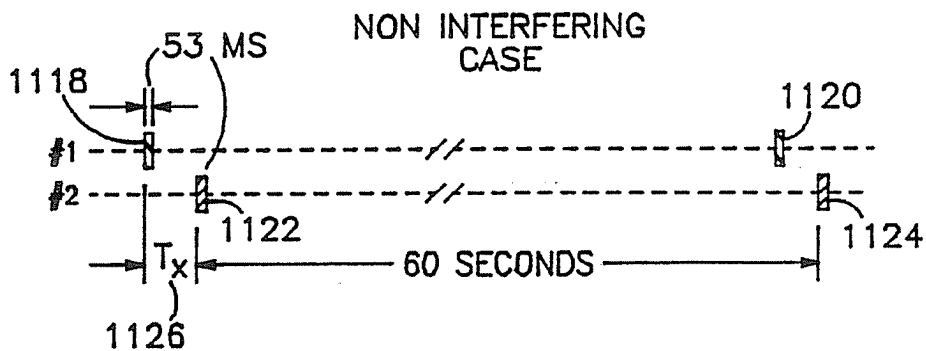
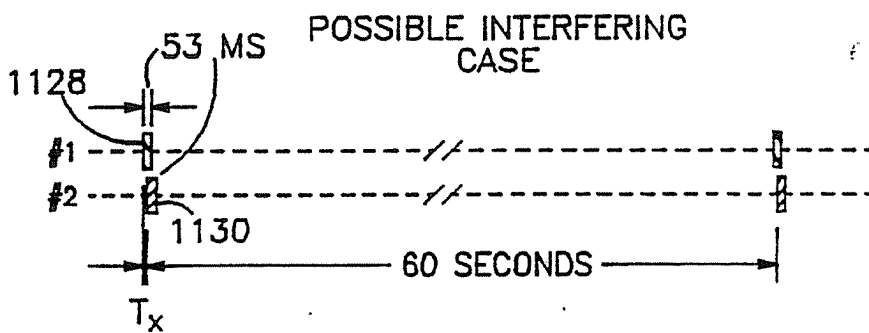
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900**FIG. 9**

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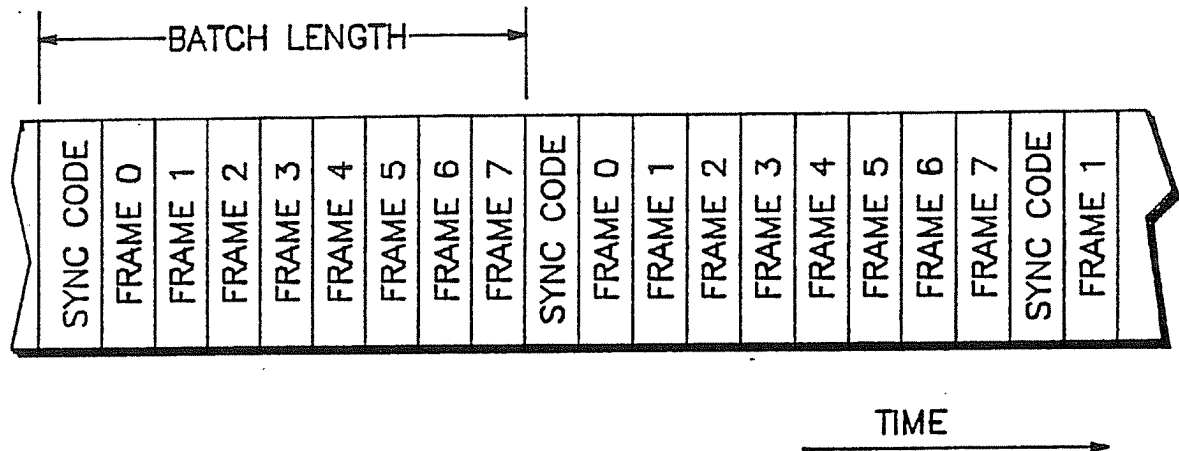


**FIG. 11A****FIG. 11B**

MULTIPLE UNIT OPERATION

**FIG. 11C**

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**FIG. 13A****FIG. 13B**

1	2 TO 19	20/21	22 TO 31	32
MESSAGE FLAG=0	ADDRESS BITS	FUNCTION BITS	PARITY CHECK BITS	EVEN PARITY

1	2 TO 21	22 TO 31	32
MESSAGE FLAG=1	MESSAGE BITS	PARITY CHECK BITS	EVEN PARITY

**FIG. 13C**

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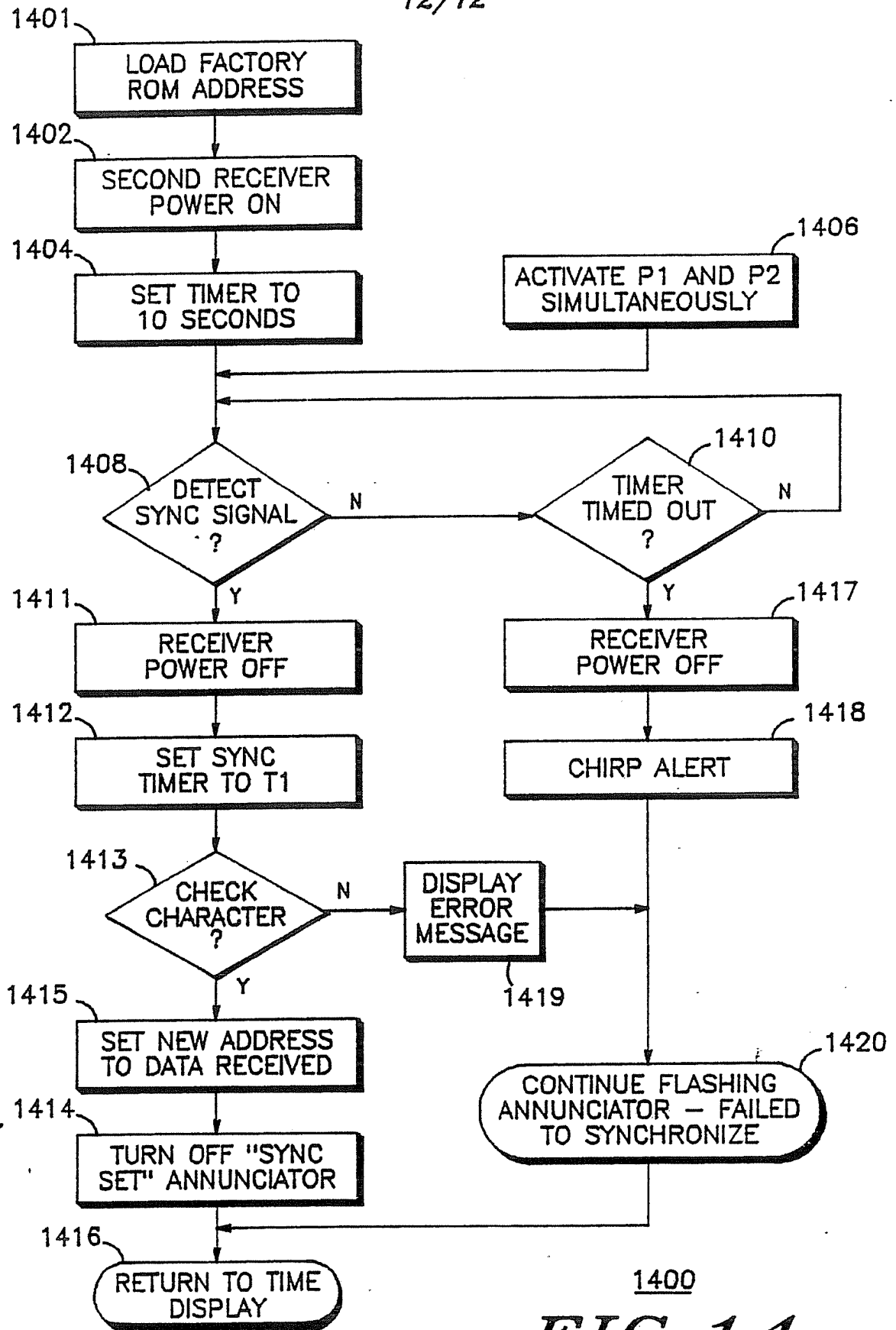
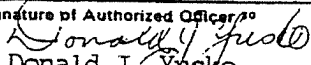


FIG. 14

# INTERNATIONAL SEARCH REPORT

International Application No PCT/US88/00919

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>1</sup> According to International Patent Classification (IPC) or to both National Classification and IPC INT. CL 4 H04B 7/15; H04 Q 7/00 U.S. CL 340/825.440; 455/11						
<b>II. FIELDS SEARCHED</b> <div style="text-align: right; font-size: small;">Minimum Documentation Searched <sup>4</sup></div> <table style="width: 100%; border: none;"> <tr> <td style="width: 30%; border: none;">Classification System  </td> <td style="border: none;">Classification Symbols</td> </tr> <tr> <td style="border: none; vertical-align: top;">U.S.</td> <td style="border: none; vertical-align: top;">340/825.440, 825.480, 825.490; 455/70, 88, 89, 11, 228, 343; 379/56, 57, 61, 170-175, 296; 375/3; 370/94, 106</td> </tr> </table> <div style="text-align: center; font-size: x-small; margin-top: 5px;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>4</sup></div>			Classification System	Classification Symbols	U.S.	340/825.440, 825.480, 825.490; 455/70, 88, 89, 11, 228, 343; 379/56, 57, 61, 170-175, 296; 375/3; 370/94, 106
Classification System	Classification Symbols					
U.S.	340/825.440, 825.480, 825.490; 455/70, 88, 89, 11, 228, 343; 379/56, 57, 61, 170-175, 296; 375/3; 370/94, 106					
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>						
Category <sup>9</sup>	Citation of Document, <sup>16</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>14</sup>				
X Y	U.S. A, 4,649,385 (Aires, et al) 10 March 1987 See Figure 1, means 10, 13, 20; Figure 3, Abstract, columns 2, 3, 6, 7, 17, 22.	.1 <u>2-19</u>				
X	U.S. A, 4,539,706 (Mears, et al) 03 September 1985 See Figure 1, means 10, 12.	1				
X	U.S. A, 4,172,969 (Levine, et al) 30 October 1979 See Figure 1, means 13, 22, 16, 18.	1				
Y	U.S. A, 3,937,004 (Natori, et al) 10 February 1976 See Abstract; col. 1.	16-19				
A	U.S. A, 3,984,807 (Haemmig) 05 October 1976.					
Y	U.S. A, 4,577,315 (Otsuka) 18 March 1986 See Figure 7, means 36, Abstract.	20-25				
Y	U.S. A, 4,509,199 (Ichihara) 02 April 1985 See Figure 5, means 33, Abstract.	20-25				
A	U.S. A, 4,644,347 (Lucas) 17 February 1987 See Figure 1.					
<div style="display: flex; justify-content: space-between; font-size: x-small;"> <div style="width: 45%;"> <p><sup>15</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>						
<b>IV. CERTIFICATION</b>						
Date of the Actual Completion of the International Search <sup>2</sup>		Date of Mailing of this International Search Report <sup>3</sup>				
23 May 1988		21 JUN 1988				
International Searching Authority <sup>1</sup>		Signature of Authorized Officer <sup>10</sup>				
ISA/US		 Donald J. Ynsko				

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>10</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers , because they relate to subject matter <sup>12</sup> not required to be searched by this Authority, namely:

2. ☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out <sup>13</sup>, specifically:

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>11</sup>

This International Searching Authority found multiple inventions in this international application as follows:

- I. Claims 1-19 drawn to a personal communication device;
- II. Claims 20-26 drawn to method and system for providing a battery saving function for a battery powered personal communications receiver.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☒ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.